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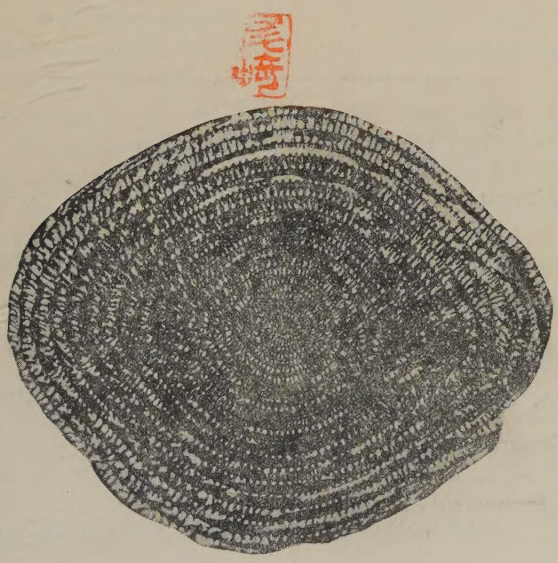

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CONTENTS

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274. NOTES ON CAMBRIAN FOSSILS FROM YENTZUYAI, TAWENKOU, IN SHANTUNG*

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山東省大汶口燕子崖産の寒武紀化石について一: KEEGENBERG の採集品や MONKE のタイプを研究して Damesellidae の発生史, *Damesella paronai* や *Amphoton deois* の唇その他について新事実を見出した。MONKE の原品中に *Myona* の含まれている事も興味ある新事実として附記しておく。 小林貞一

Yentzuyai or Yentsyyai near Tawenkou on the Chinp'u railway line is a famous fossil locality in Shantung, China and Cambrian trilobites procured therefrom by F. KOERFER were thoroughly investigated by Dr. H. MONKE. A revision is, however, desirable to be done in the light of modern advancements, as it was about half a century ago. As a result of such a study on a part of MONKE's types in addition to KEEGENBERG's collection from Tawenkou, sundry notes are given here as follows:

1. Taxonomic Notes on the Trilobites from Yentsyyai.
2. Immature forms of Miomeric Trilobites.
3. Early Ontogeny of the Damesllidae.
4. *Teinistion magna* KOBAYASHI, new species.
5. *Stephanocare* (?) *bergeroni* KOBAYASHI.
6. Hypostoma of *Damesella paronai* (AIRAGHI).
7. Hypostoma of *Amphoton deois* (WALCOTT).
8. *Amphoton* (*Sunia*) *tellus* (WALCOTT).
9. *Entorachis*, a new subgenus of *Psilaspis* RESSER and ENDO.
10. *Myona flabelliformis* KOBAYASHI.

For the privilage of studying these specimens I am very grateful to Prof. H. O. SCHINDEWOLF of the University at Tübingen, Germany.

1. Taxonomic Notes on the Trilobites from Yentsyyai.

Putting aside some hypostomata and larval forms of doubtful position MONKE (1903) described eight species of trilobites as follows:—

Agnostus koerferi MONKE=*Pseudagnostus douvillei* (BERGERON), 1899.

Liostracina krausei MONKE

Teinistion lansi MONKE = { *Teinistion lansi* MONKE; *Teinistion monkei* KOBAYASHI, new species. See page 93.

* Read at the 61th Meeting of the Palaeontological Society of Japan, June 18th, 1955, at Kyoto; received June 10, 1955.

Teinistion sodeni MONKE = { *Blackwelderia* ex. *sinensis* (BERGERON), 1899 / *Blackwelderia paronai* (AIRAGHI), 1903

Drepanura premesnili BERGERON
Drepanura ketteleri MONKE
Stephanocare sinensis BERGERON
Stephanocare (?) sp.=*Blackwelderia monkei* (WALCOTT), 1911.

Agnostus koerferi is inseparable from *Agnostus douvillei*. *Agnostus pii* AIRAGHI, 1902, is probably a small form of the same species in poor preservation. All of them occur in the Kushan stage in Shantung and belong to *Pseudagnostus* (KOBAYASHI, 1939). As noted elsewhere, (1942), the cranidia on which MONKE founded *Teinistion sodeni* appear to be those of *Blackwelderia* ex. *sinensis* in immature stages. MONKE's pygidia of the same species may be those of *Blackwelderia paronai* in the stage before the sixth pair of short spines appear. MONKE's *Stephanocare* (?) sp. represents *Blackwelderia monkei*.

2. Immature Forms of Miomeric Trilobites.

Among MONKE's larval shields the smallest and simplest is an elliptical one about 0.5 mm. long. (Taf. 6, Fig. 15). It is truncated by a straight articulating margin whence a broad axial lobe tapers distally, forming a cone. It is quite different from any larval form of polymeric trilobites, but is similar to an immature pygidium of *Peronopsis intiger* (BARRANDE), 1852, although the marginal border is not shown.

On the slabs I examined none looks like that larva, but there are a few small pygidia which are suggestive of Eodiscidian affinity. They resemble at the same time the pygidium of WALCOTT's *Shumardia* (?) sp. (1913) from the Changhia limestone in Shantung. The shield is long, ovate, truncated by an arcuate anterior margin and divided into three subequal lobes by axial furrows and into some 9 segments by transverse furrows; axial lobe distinctly elevated above the gently convex pleural ones; some axial rings bearing relatively large median tubercles; marginal border absent or unpreserved.

3. Early Ontogeny of the Dameselidae.

There are several metaprotaspids of polymeric trilobites, but they are mostly ill-preserved. Two best ones illustrated in figs. 14 and 15 are similar to MONKE's (Taf. 6, Fig. 16; pl. 14 Fig. d), but disagree with his primarily in the posterior outline. These two larvae are not much different in size of the dorsal shield or in proportion between the head and tail. The divisional line and occipital furrow are fairly distinct. The axis is more or less fusiformed in the A form (0.79×0.64 mm), while it narrows regularly backward in the B form (0.78×0.65 mm).

In both of them the dorsal furrow is deep and expanded into a triangular depression at the anterior extremity. There the periphery of the shield is transversal or broadly arcuate. The segmentation becomes indistinct in the distal sides of the axis. No eye-band is seen. The axial lobe of the pygidium is apparently composed of 2 rings and a terminal lobe. Pleural furrows are indiscernible. The posterior margin of the pygidium is nearly transversal and there appears to be a tiny process at the lateral end.

WALCOTT's trisegmented metaprotaspid which was procured from Yenchuang (C_6), Shantung, in association with *Agnostus koerferi*, *Shantungia spinifera*

and *Stephanocare richthofeni* is similar to the larva MONKE illustrated, but the glabella is very broad in WALCOTT's.

A precise comparison among those four larvae shows some differences a part of which is attributable to the matter of preservation and another part to growth change among metaprotaspids. Still another part depends upon taxonomic difference. Nevertheless they are so similar to one another that they are presumed to belong to the same family.

For the purpose to determine their taxonomic position the frequency of occurrences is now brought into consideration. The number of dismembered carapaces counted on MONKE's Tafel 9 is tabulated below.

Agnostus koerferi.....46	Agnostidae.....46		
Liostracina krausei 52	Liostracinidae 52		
Teinistion lansi.....72	Dorypygellinae 160	Damesellidae 316	
Drepanura premesnili 79			
Drepanura ketteleri 9			
Stephanocare richthofeni 155	Damesellinae 156		
Stephanocare (?) sp. 1			
Hypostomata 20			

Thus it is evident for the larvae that the probability of their reference to the Damesellidae is so high that the Liostracinidae can be ignored. It is then extraordinarily interesting to find two kinds of metaprotaspids with and without a pair of lateral processes on the pygidium. The spiniferous form must be the larva of the Dorypygellinae, assuming the process to be the progenitor of a long spine. The other would be of *Stephanocare*, and if so, of *Stephanocare richthofeni*.

In 1939 ENDO has illustrated an excellent ontogenetical series of *Blackwelderia quadrata* which is intimately related to *B. paronai*, if not identical. There are, however, some gaps in the series between the protaspid and meraspid stages (Figs. a–c, e–g). His latest anaprotaspids (1939 B, pl. 1, figs. 10–12) have transitory pygidia or protopygidia, no mention being, however, given of their segmentation. The proportional size of the pygidium to the cephalon is much smaller in them than in the metaprotaspids above referred to. Supplemented with them, the early ontogeny of the Damesellidae can now be figured out completely.

The late anaprotaspid of *B. quadrata* has the eye-band extending from the neck of the frontal lobe laterally and then posteriorly along the lateral margin. In this respect it is similar to the middle metaprotaspid of *Redlichia chinensis* and the late anaprotaspid of *Paradoxides pinus* (?), although the cheeks are not segmented as in *R. chinensis* and the frontal lobe of the glabella not bilobed as in *P. pinus*.

It is allied also to *Palaeolenus deprati* MANSUY in the anaprotaspid stage, but in the latter the preocular area is smaller and narrower; the glabella contracted at the fifth lobe (LU, 1942). The cephalon of the latter, 0.7 mm long, is quite distinct from that of *B. quadrata* in the metaprotaspid stage or meraspid stage, but very similar to the cephalon (fig. 1e) in the nepionic stage which WALCOTT (1913) referred to *Amphoton deois*.

In the anaprotaspid stage the Damesellidae are quite distinct from the Olenellidae and closer to the Redlichidae,

Dolerolenidae and Paradoxidae than to the Olenidae, Andrarinidae (Liostracidae) and Asaphiscidae (*Blainia ?*).

The metaprotaspids of the Dameselinae are quite different from those of the Olenellidae and Paradoxidae. In the Damesellidae there is no genal spine as seen in *Olenus*, *Sao* or *Dalmanitina*. Furthermore it is remarkable that the eye-band is indiscernible and either the frontal lobe or the occipital one is no more expanded than the three intermediate lobes. The glabella is gently tapering back at the beginning, but later it becomes subcylindrical and rounded in front. On each side of the frontal lobe there is a triangular depression. It becomes larger and united with its counter in a lunate depressed frontal border in the meraspid stages of *Blackwelderia quadrata*. This is an incipient preglabellar depression which is quite developed in the cranidium of *Blackwelderia paronai* in the full grown stage.

Eye bands exist on the meraspids of *B. quadrata*. By their inward migration there appear free cheeks. Still later the eyes become smaller and eye-ridges are effaced as can be seen in the adult of *Blackwelderia*.

The early meraspid cephalon of *B. quadrata* is somewhat similar to that WALCOTT (1913) referred to *Amphoton deois* (fig. 1d) or *Fuchouia manchuriensis*. Similar larvae are, however, found in the east of Liaoyang in a Tangshihan shale with *Proasaphiscus yabei* but without *Amphoton* or *Fuchouia*. MONKE's meraspid cephalon (Taf. 6, Fig. 17) is different from the precedings in the absence of eye-bands. Whether it belongs to the Damesllidae or the Liostracinidae is a question.

The early holaspid cephalon of *Liostracina krausei* (Taf. 3, Fig. 13) can easily be distinguished from those of *Stephanocare richthofeni* (Taf. 7, Fig. 6), *Teinistion lansi* (Taf. 4, Fig. 6) and *Drepanura premesnili* (Taf. 5, Fig. 9) by the short glabella and obscurity of the eyes. The eyes are small and located far anteriorly in *D. premesnili*, while they are large in *Teinistion* and *Stephanocare* and located in the middle in *S. richthofeni* and in the posterior in *T. lansi*. Thus these cranidia are already not essentially different from their adults.

4. *Teinistion magna* KOBAYASHI, new species

Pl. 14, Fig. 12.

This cranidium from Tawenkou is the largest of the genus I ever saw. It measures 14.5 mm in length.

Glabella long, conical, provided with an occipital and two lateral furrows; fixed cheek narrow; eyes fairly large, opposed in the posterior of the cranidium; eye-ridge quite oblique; two weak oblique folds seen behind the ridge; anterior rim straight and remarkably erected; a groove between the frontal limb and rim very broad and concave.

A further note given in the description of the genus.

Genus *Teinistion* MONKE, 1903

1903. *Teinistion* MONKE, *Jahrb. königl. Preuss. Geol. Landesanst. u. Bergakad. Bd. 23, Hft. 1*, p. 117.
1913. *Teinistion* WALCOTT, *Cambrian Faunas of China*, p. 109.
1935. *Teinistion* KOBAYASHI, *Jour. Fac. Sci. Imp. Univ. Tokyo, Sec. 2, Vol. 4, Pt. 2*, p. 254.

Diagnosis:—Dorypygellinae with broad cephalon, cylindrical or truncato-conical, narrow glabella, eyes of medium size located posteriorly and oblique eye-ridges.

Type species :—*Teinistion lansi* MONKE, 1903.

Specific list :—The present determination is cited on the right side.

Teinistion lansi MONKE, 1903, in fig. 1, pl. 1 only.	*Teinistion monkei* KOBAYASHI, new species
Teinistion sodeni MONKE, 1903	*Blackwelderia* ex. *sinensis* (BERGERON)
	Blackwelderia paronai (AIRAGHI)
Teinistion alcon (WALCOTT), 1913	*Dorypygella alcon* WALCOTT, 1905
Teinistion subconica SUN, 1924	ditto
Teinistion truncatus ENDO, 1937	ditto.
Teinistion sulcatus ENDO, 1937	*Dorypygella* ? *sulcata* (ENDO)
Teinistion obtusus ENDO, 1937	*Dorypygella* ? *obtusa* (ENDO)
Teinistion lanciforme ENDO, 1944	*Teinistion* ? *lanciforme* ENDO

Remarks :—I once considered that *Teinistion* is a member of the Emmerichellidae, but as discussed later (1941), it is a close relative of *Dorypygella*, as WALCOTT has synonymized it with *Teinistion*. In MONKE's ontogenetical series of *T. lansi* the youngest cranidium (Taf. 4, Fig. 6) looks more similar to *Dorypygella* than *Teinistion* in the adult stage. It has a conical unfurrowed glabella and large eyes, but no oblique folds on fixed cheeks. Diminution of the eyes, development of eye-ridges and oblique folds and the sinuation of the anterior border are shown by MONKE to be morphic changes through growth.

According to his ontogenetical series of *T. lansi*, the cylindrical glabella is introduced from the conical one. The cranidium in Taf. 4, Fig. 2 is assigned here as the lectotype of *Teinistion lansi*.

Because it is quite improbable that the conical glabella appears again in a still later stage, *Teinistion monkei* is proposed for the cranidium in Taf. 4, Fig. 1, MONKE, 1903, having a truncatoconical glabella.

There are, in addition, a few other species having this kind of glabellae. ENDO's *truncatus* is different from *monkei* in the absence of the oblique folds on the fixed cheeks.

SUN's *conica* has pustulose test, while all others of this genus have smooth ones. The development of the preglabellar area is the distinct feature of of *T. magna*.

Distribution:—Kushan stage of Eastern Asia except for *T.* (?) *lanciformes* from the Taitzuan of Hualienchai, South manchuria.

5. *Stephanocare* (?) *bergeroni* KOBAYASHI

Pl. 14, Fig. 9.

Damesellid pygidia have spines in 5 to 8 pairs one or two pairs of which are often longer than the others. Five or eight pairs of spines are, however, met with not so commonly as 6 or 7 pairs. *Stephanocare* (?) *bergeroni* from the *Drepanura* zone of South Korea is such an uncommon form having 5 pairs of spines on the pygidium.

A pygidium from Yentsyyai, fits with the South Korean one nicely. The lack of an intramarginal groove in the Shantung specimen does not mean any taxonomic distinction, because the groove in the Korean specimen must be a surface impression of the doublure which came out secondarily.

6. Hypostoma of *Damesella paronai* (AIRAGHI)

Pl. 14, Fig. 8.

All of detached carapaces on a marl

specimen from Tawenkou belong exclusively to *Cheirurus paronai* AIRAGHI, i.e. *Damesella blackwelderi* WALCOTT. Among three hypostomata in the small slab a well preserved one reveals a great similarity to WALCOTT's (1913, pl. 10, fig. 13), but the posterior outline is remarkably expaned laterally.

The central body is subelliptical, but the posterior ridge and groove are fairly acute. Surrounding its middle and posterior parts and separated from it by a relatively deep groove, the flat border is expanded laterally. The posterior border which forms a shallow sinuation is narrow. The antero-lateral wing is undeveloped.

7. Hypostoma of *Amphoton deois* (WALCOTT)

Pl. 14, Figs. 13a-b.

A hypostoma on a limestone slab from Tawenkou (?) is referable to *Amphoton deois*, because all other dismembered carapaces on the slab belong to the species, if *Peronopsis chinensis* is overlooked. It resembles WALCOTT's hypostoma of the species (1913, pl. 22, fig. 1c), but by cleaning the matrix, the anterior wings are found much larger.

The outline of the hypostoma is subtriangular; central body subovate, strongly vaulted, provided with a low lunate band on the rear side and surrounded by a narrow rim; anterior margin slightly arcuate; antero-lateral wing very large, trigonal, depressed and distinctly slant laterally.

This is somewhat similar to the hypostoma of *Amphoton* (*Sunia*) *typica* KOBAYASHI (1942, pl. 1, fig. 15), but evidently more triangular in outline, in which respect the hypostoma of *Athabaskia belus* (WALCOTT), 1916, may be comparable to it.

8. *Amphoton* (*Sunia*) *tellus* (WALCOTT)

Pl. 14, Figs. 10-11.

Lonchocephalus tellus was proposed by WALCOTT (1913) for a poorly preserved cranidium from Yenchuang, Shantung. Though not much better preserved, some specimens from Tawenkou allow me to figure out its cephalon.

Glabella subquadrate, a little longer than broad, gently convex and unfurrowed except a shallow occipital furrow; a long spine protruded from a small subtriangular neck ring; eyes large, set close to the glabella; frontal border fairly large, more or less elevating up- and for-ward; free cheek provided with a genal spine; facial suture anterior to the eye subvertical, but a little bowing laterally.

Such a nuchal spine is seen in *Annamitia*, *Redlichaspis*, *Lonchocephalus*, *Saratogia*, *Idahoia* and a few other genera, but they have frontal limbs of different size. In my opinion this is most probably a *Sunia* having a shorter glabella than that of *Sunia typica*.

9. *Entorachis*, a new subgenus of *Psilaspis* RESSER and ENDO

Psilaspis typified by *Psilaspis manchuriensis* RESSER and ENDO has a conical glabella. *Entorachis* is proposed here to include *Psilaspis* but having a parallel-sided glabella. *Anomocare alcione* WALCOTT, 1913, is the type of this subgenus and *Ptychoparia* (*Conocephalites*) *memor* REED, 1910, can safely be referred to it.

The glabella is also parallel-sided in *Haniwa* and some species of *Eymekops*, but the eye-band is much larger in them than in *Entorachis*. The posterior end of the eye is located close to the glabella and the frontal margin of the straight and transversal in *Haniwa*,

whereas the margin is rounded and the end of the eye apart from the glabella in *Entorachis*.

Insofar as the cephalon is concerned, the most resembling may be *Wilbernia* WALCOTT, 1924, but it is distinct from *Entorachis* in two pairs of lateral furrows distinctly impressed on the glabella internally. They are far from confusion, if their pygidia are compared. Pleural furrows are quite pronounced in WALCOTT's *Ptychoparia ? diademata* (1899) for which RESSER (1937) proposed *Wilbernia hudsonensis*. The furrows are well developed also in WILSON's *Wilbernia* sp. indet (1954).

The distribution of the subgenus is restricted to the Middle Cambrian in Eastern and Southern Asia.

Psilaspis (*Entorachis*) *shantungensis* KOBAYASHI, new species

Pl. 14, Fig. 1-4.

Cephalon exclusive of genal spines semicircular. Cranidium as long as broad; glabella outlined by dorsal furrows long, cylindrical, rounded in front, gently convex and devoid of lateral furrows; fixed cheek relatively broad; eyes fairly large, semicircular, opposed a little posterior to the middle of the glabella and connected with it by an oblique and straight narrow eye-ridge; frontal limb gently inclined forward and merges with a flat or a little concave frontal border. Free cheek with a genal spine. In the internal view the doublure is remarkably broadened at the genal spine. Facial sutures short and diagonal behind the eyes and less divergent in their anterior.

Pygidium semicircular; axial lobe delimited by a deep axial furrow on each side and elevated above the broad gently convex pleural lobes; marginal border concave.

Compared to *Entorachis alcione* the glabella is more slender in this species. In *alcione* there is a narrow intramarginal ridge which is most probably the impression of the inner edge of the doublure. It is abruptly bent inward near the genal angle. *Entorachis memor* REED (1910), especially the cranidium in fig. 4, pl. 4, looks similar to this species, but distinct in the strong occipital furrow. According to REED the occipital ring carries a median tubercle; axial furrow pitted at the anterior end and the test granulose. Furthermore the marginal furrow appears more distinct, although it is said indistinct and shallow.

Occurrence :—Tawenkou, Shantung.

10. *Myona flabelliformis* KOBAYASHI

Pl. 14, Figs. 5-7.

This is an enigmatic creature possibly of Arthropodan nature. It was first found in the *Drepanura* zone of the Seison slate in South Korea which belongs to the Kushan stage. It is extraordinarily interesting to find the same kind of fossils in the same stage at Yentsyyai in Shantung.

With the Korean specimens it was ascertained that the carapace is equivalved and almost equilateral. The median part of the dorsal margin appears somewhat protruded above in form of an umbo, but there is no hinge apparatus. Therefore it is probable that the two valves were fused along the dorsal margin.

The Shantung specimens are internal moulds of detached valves. Because they are detached from each other, it is presumable that the two valves were connected along the dorsal margin not in the whole length but only in the umbonal portion. The carapace valve is taller on one side than on the other,

but it is difficult to answer which is the front or back. It is flat but abruptly turns inward near the periphery.

Internally there are numerous radial ridges which are separated into an inner and outer series by a deep and broad concentric sulcus. This aspect of internal relieves reminds me of the diverticula of the digestive tube in *Burgessia bella* WALCOTT. The carapace is, however, not truncated in the rear part as in that species.

Because there is no trace of trilobation, *Myona* may be a member of the Pseudostraca or Hymenocarina. The internal structure prevents me to refer *Myona* to the Ostracoda, Ribeirida or Bradorina. It may be combined with *Septadella* STUBBLEFIELD, 1933, in an unnamed group of the Pseudocrustacea. The lack of the concentric sulcus is the distinction of that genus from *Myona*.

Finally it is noted that *Myona flabelliformis* occurs at Tayüyaotze, Tsinghuiho region, Inner Mongolia (清水河県打漁窰子) in the *Drepanura* zone together with *Drepanura premesnili*, *Blackwelderia paronai*, *B. sinensis*, *Stephanocare richthtofeni*, *Liostracina krausei*, *Ordosia fimbricauda* and *Lorenzella* sp. (LU, 1954).

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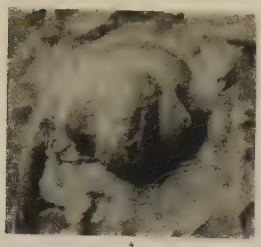
Explanation of Plate 14

Psilaspis (*Entorachis*) *shantungensis* KOBAYASHI, new species ..... p. 95
Figure 1. Holotype cranidium, ×1
Figures 2–4. Cranidium, free cheek and pygidium, ×1
Myona flabelliformis KOBAYASHI ..... p. 95
Figures 5–7. a–c valves, ×4
Damesella paronai (AIRAGHI) ..... p. 93
Figure 8. Hypostoma, ×1.5
Stephanocare (?) *bergeroni* KOBAYASHI ..... p. 93
Figure 9. Pygidium, ×1.5
Amphoton (*Sunia*) *tellus* (WALCOTT) ..... p. 94
Figures 10–11. Cranidium and free cheek, ×1.5.
Teinistion magna KYBAYASHI, new species ..... p. 92
Figure 12. Cranidium, ×1.5
Amphoton deois (WALCOTT) ..... p. 94
Figures 13 a–b. Ventral and lateral views of a hypostoma, ×3
Metaprotaspids of Dorypygellinae ..... p. 90
Figures 14 and 14a. B form, × ca. 30
Figures 15 and 15a. A form, × ca. 30
Early ontogeny of Damesellidae ..... p. 90
Figures a–c. Early, middle and late anaprotaspids of *Blackwelderia quadrata* ENDO respectively in Figs. 1b (×36), 3b (×10) and 5b (×20) in ENDO (1939A).
Figure d. Metaprotaspid of Damesellinae or *Stephanocare* in MONKE, 1903, Taf. 6, Fig. 16, ×15.
Figures e–g. Early, middle and late meraspid cephala of *Blackwelderia quadrata*, respectively in Figs. 6b (×15), 7b (×14) and 9b (×10) in ENDO (1939A).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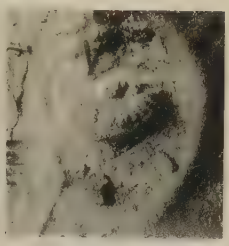
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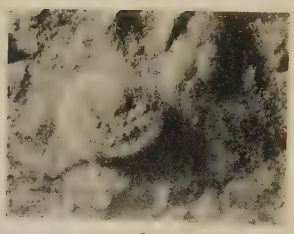
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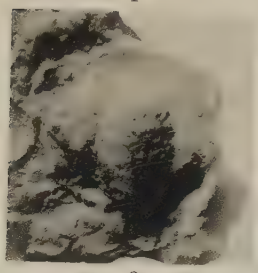
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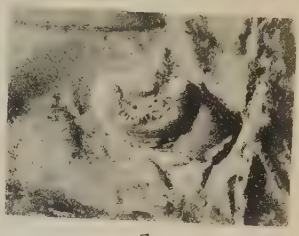
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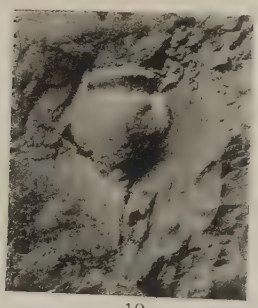
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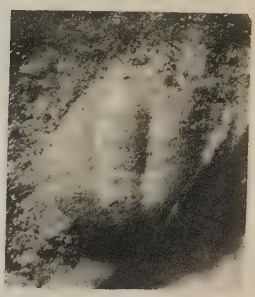
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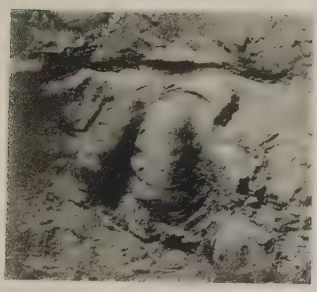
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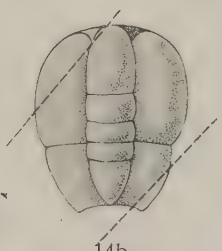
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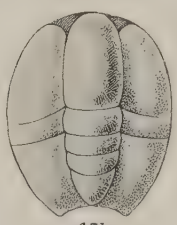
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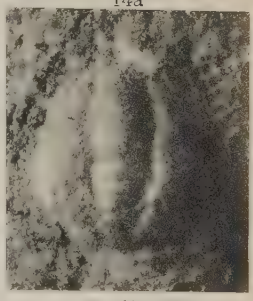
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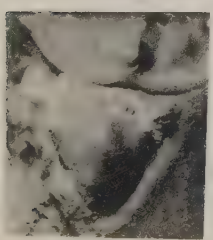
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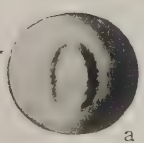
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Trans. Proc. Palaeont. Soc. Japan, N. S., No. 20, pp. 99—100, Pl. 15, Dec. 30, 1955

275. CRETACEOUS ECHINOID, *NIPONASTER* FROM THE ISLAND OF AWAZI, JAPAN*

AKIRA MORISHITA

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淡路の白亜系から産出した *Niponaster* について： *Niponaster* 属は以前に北海道の白亜系から産出した *Ananchytinarum* sp. に対し J. LAMBERT が与えた名称であるが，原記載が簡単で，特に下面の特徴がほとんど知られていない。筆者は今回，淡路から産出した標本について，いくつかの新しい特徴を補足的に記載した。 森下 晶

One specimen of echinoid from the Izumi Group of Awazi was just examined by the author. The occurrence of some fossil echinoids was reported by SASAI and others together with several Ammonites, Belemnites, *Inoceramus* etc. (*Jour. Geogr., vol. 6*, p. 109, 1894; *Jour. Geol. Soc. Japan, vol. 43*, p. 600, 1936) SASAI referred an European species, *Ananchytes ovatus* (LESKE) to one of his material without giving any palaeontological note.

This form to which the present specimen under examination belongs is identical with *Niponaster hokkaidensis* LAMBERT of Hokkaido. As LAMBERT's description of this species is not very precise, a supplementally diagnostic features of *Niponaster* is given in the following lines.

Description of Species

Genus *Niponaster* LAMBERT 1920

Niponaster hokkaidensis LAMBERT

Pl. 15, figs. 1-3

1894. *Ananchytinarum* sp. indet., K. JIMBO, p. 45, Taf. IX, fig. 8.

1950. *Niponaster hokkaidensis* TH. MORTENSEN, p. 170, fig. 132.

Description:—The test is large, high and round in outline. The abactinal surface is arched from the ambitus to the apex. The actinal surface is flat or slightly concave and sunken only adorally. The posterior interambulacrum is somewhat elevated. There is no frontal depression.

The apical system is small and at about the centre. The genital pores are indistinct.

All the petaloidal ambulacra are nearly equal in its shape, namely the odd one is not well differentiate from the others. The ambulacra are not depressed, open and nearly reach to the margin of the test. They are straight and gradually widened towards the distal ends. The poriferous zones are broad and the interporiferous narrow (width at the distal end: 5.8 mm, 2.3 mm). The ambulacral and interambulacral plates are larger at the lower part than at the upper. The tubercles are indistinct.

The peristome is at the 1/4 diameter from the anterior ambitus, depressed and transversely oval. The periproct is oval and inframarginal posteriorly. The posterior interambulacrum forms sternum and amphisternous.

The marginal fasciole is indistinct.

* Read June 18, 1955; received June 27, 1955.

Measurements :—

Longitudinal diameter	: 78 mm (deformed)
Transverse diameter	: 87 mm (deformed)
Height	: 44 mm (deformed)

Observations and Remarks : — This deformed specimen seems to have been originally higher and longer than the above measurements. In view of the shape of abactinals, the ambulacra IV is in the front. But the positions of peristome and periproct in the actinal side clearly show the exact antero-posterior direction. On the abactinal surface, the left half is narrow compared with the widened right. Presumably J. LAMBERT proposed the genus *Niponaster* without the specimens at his hand. Therefore, JIMBO's poor description, of *Ananchytinarum* sp. indet. seems to be only one to show certain characters of *Niponaster*. JIMBO shortly mentions as follows: "Zwei sehr zerquetschte Stücke liegen als einzige Echiniden-Reste vor. Die Schale ist sehr abgerieben, und von der Unterseite ist nur der Rand theilweise zu beobachten. Mund- und Afteröffnungen sind nicht erhalten. Die Körner auf der Oberfläche sind nur an der Unterseite deutlich und mit Höfen versehen. Ambulacra einfach, mit schmalen porenstreifen, breiter gegen den unteren Theil, aber auf der Unterseite nicht mehr vorhanden. Die porenpaare stehen entfernt und einreihig. Das Scheitelschild fast compact, aber nicht gut erhalten.

Fundorte: Mergelknollen von Urokobets und dem oberlauf des Yubari, nahe der Mündung des Pankemoyubari."

With this description, the actinal feature is not known. The present observations clarified the amphisternous character of the plastron that have never been accepted by Th. MORTENSEN. Accordingly the Genus *Niponaster* is not allied to *Stenonaster* or *Menuthiaster* (Meridosternata), but to Amphisternata.

Matrix :—Shale

Geological Horizon : — Minato Shale, upper part of Izumi Group (up. Cretaceous)

Locality :—Near Minato-machi, Mihara-gun, Hyogo Prefecture

Acknowledgements. — The acknowledgements must be indebted to Mr. Y. TUCHIGA and Mr. T. YASUDA for their kindnesses offering the valuable specimen, Mr. Y. MAEDA for his kind suggestion on the geological age and Professor J. MAKIYAMA of Kyoto University for reading over the manuscript. This specimen is due to be deposited in Mr. TUCHIGA's hand.

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MORTENSEN, Th. (1950), A Monograph of the Echinoidea, V_1, Spatangoida 1.

SASAI, H. (1936), The Izumi Sandstone Series in Awazi, *Jour. Geol. Soc. Japan, Vol. 43,* No. 515.

Explanation of Plate 15

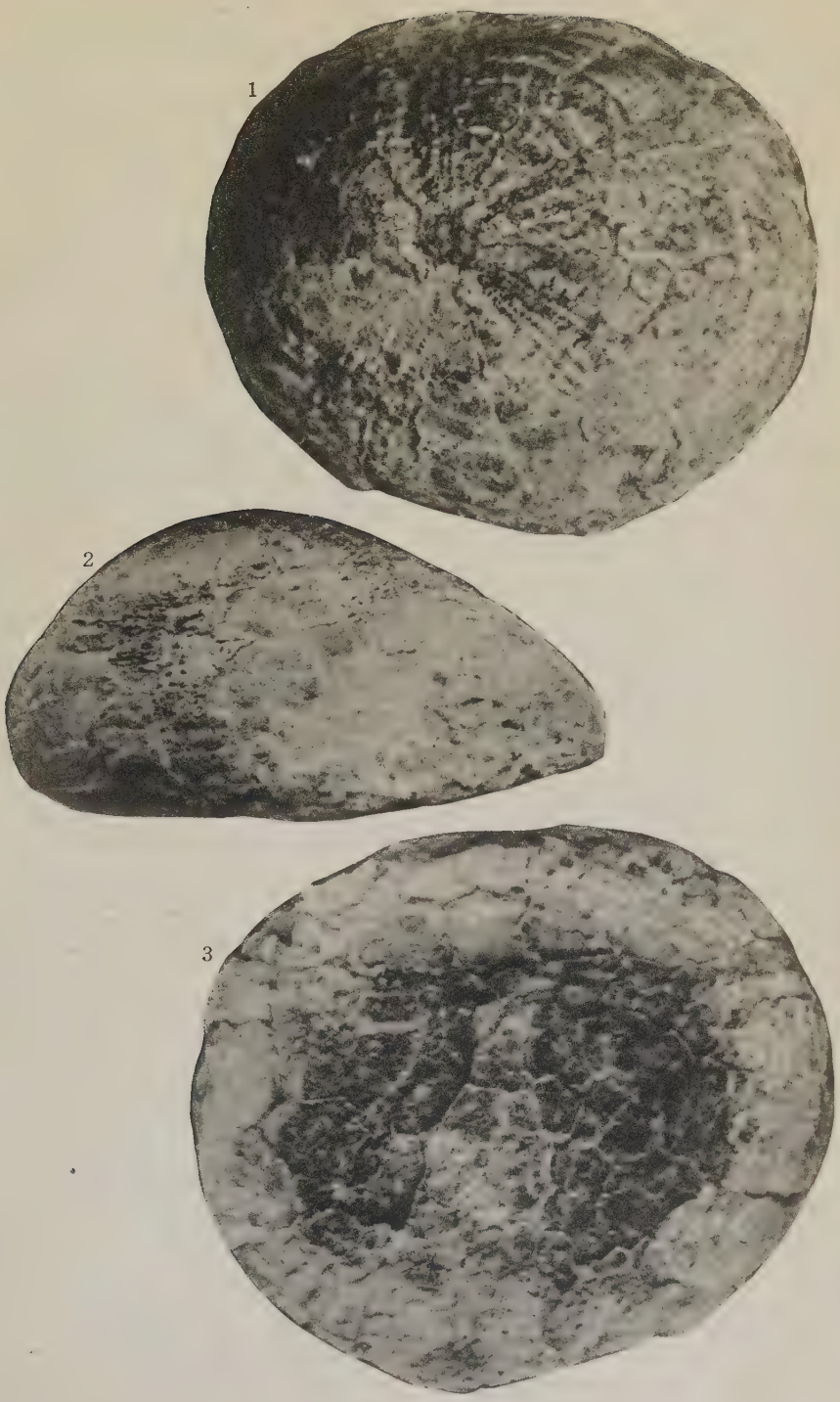
(All figures in natural size)

Niponaster hokkaidensis LAMBERT

Fig. 1. Abactinal side. Upper part of the figure shows the front.

Fig. 2. Posterior profile. Two ambulacra show the posterior paired ambulacra.

Fig. 3. Actinal side. Upper part of the figure shows the front. Peristome and the amphisternous character of plastron are distinct.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Trans. Proc. Palaeont. Soc. Japan, N. S., No. 20, pp. 101-110, Pls. 16-17, 4 text-figs, Dec. 30, 1955

276. *AMUSSIOPECTEN* FROM THE MIYAZAKI GROUP, MIYAZAKI PREFECTURE, JAPAN, (Paleontological Study of the Tertiary Miyazaki Group)*

TSUGIO SHUTO

Department of Geology, Faculty of Science, Kyushu University.

宮崎層群産 *Amussiopecten*: *Amussiopecten* は元来中新世の属であるが，日本とその近接地域のみで，むしろ下部鮮新世の指準化石として知られ，中新世からは，はつきりした種は報告されていない．筆者は宮崎層群の上部から鮮新世種 *A. praesignis* を，下部からそれとは別個の種をかなり多数採集した．その中新世種の層位的意義を認めて記載する．　首藤次男

Introduction

The purpose of this brief note is mainly to describe two species of *Amussiopecten* from the Miyazaki group of Miyazaki Prefecture, south east Kyushu, with some discussion on their bearing in biostratigraphy. Before entering into the subject the definition and the taxonomic position of the genus are here remarked.

Genus *Amussiopecten*, well known in south Europe as an index genus of Miocene, was established by SACCO in 1897 on the basis of *Pecten burdigalensis* LAMARCK. The generic diagnosis may be described as follows: convex right valve and plano-covex left balve; both valves provided with numerous exterior radial ribs, which are distinct near the beak and diminish as shell grows, and with interior ribs reaching the ventral margin.

Two forms have been considered as being closely related to this genus, *Flabellipecten* SACCO 1897 and *Oopecten* SACCO 1897 ("Gruppe der *Pecten rotundatus* LAMARCK" of PHILIPPI or "groupe du *Chlamys rotundata* (LAMARCK)" of Jean ROGER). These forms represent the transitional position between *Amussiopecten* and *Pecten* or *Chlamys*. Therein H. E. PHILIPPI supposed that *Amussiopecten* and the allied two genera had differentiated from "normal *Aequipecten*" in the environment of the tropic water in a certain age of older Tertiary. He furthermore assumed that *Amusium* belonged to a quite different lineage from that of *Amussiopecten*. However *Amussiopecten* actually resembles *Amusium* RUMPHIUS 1711 em. KLEIN 1752 in general feature except that the latter is provided with equally convex valve and more prominent interior ribs and is devoid of exterior ribs. On the foundation of the comparative anatomy modern taxonomists set *Amusium* and *Amussiopecten* in subfamily Amusiinae

* Read at the Meeting of the Nishi-Nippon Division of the Geological Society of Japan at Fukuoka, Oct. 15, 1954; received July 14, 1955.

and *Pecten* and *Chlamys* in subfamily Pectininae. The present writer adopts this classification.

Text fig. 1
Distributed Area of the Miyazaki Group.

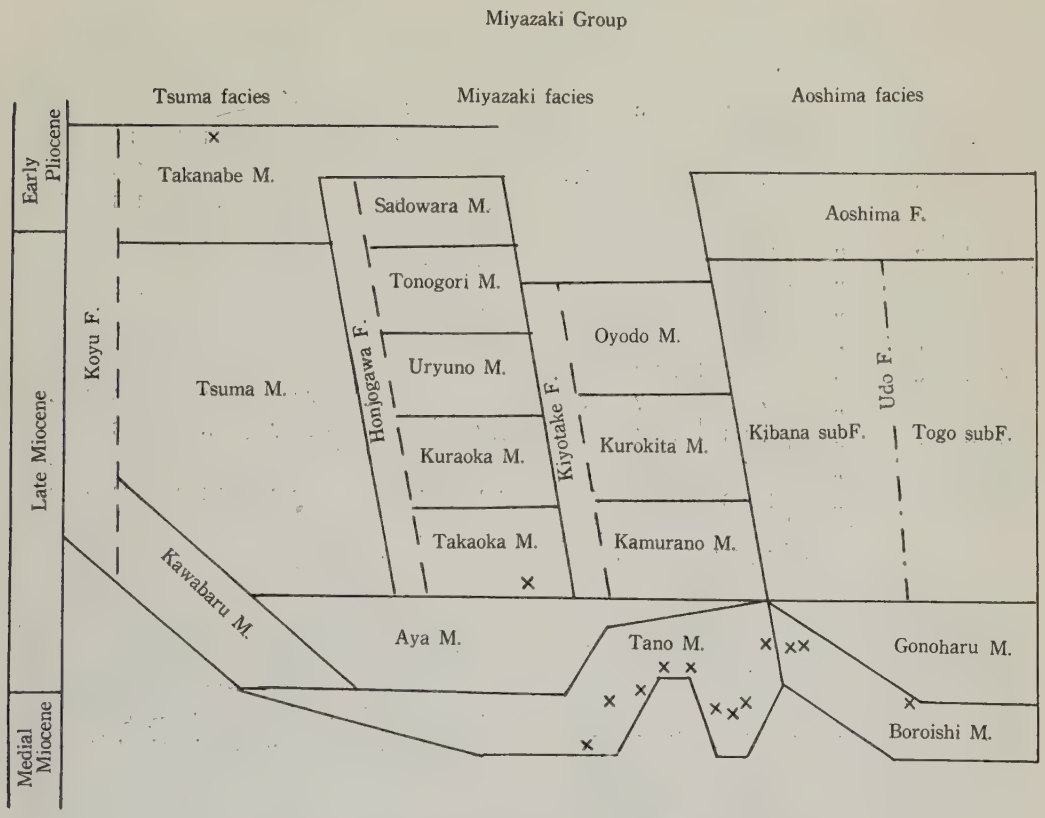
Various species of *Amussiopecten* have been reported from the Mediterranian basin and the Pannoic basin in Europe. Their geological ranges are generally limited in Burdigalian and Vindovonian, especially in Helvetian, with an exception of *A. burdigalensis*, which begins to appear in upper Aquitanian. The genus occurs, outside Europe, in Egypt, Iran and Indonesia and its age is again Miocene. However in Japan and adjacent islands it has been regarded as an index fossil of Early Pliocene rather than Miocene. Of the three species of the genus which have been reported in this country*, the most familiar species, *A. praesignis* (YOKOYAMA), occurs frequently in the Lower Pliocene on the Pacific side of southwest Japan and also in that of Ryukyu and Formosa. Of course, *Amussiopecten* is not utterly absent in the Miocene strata; it has been reported from the Sagara group, the Sizukawa beds and the Siroyama sandstone in Sizuoka Prefecture and from the Kaisan beds in Formosa. However, its occurrence in Miocene is much less common than in Pliocene, and some paleontologists doubt that certain Miocene specimen which were identified as *A. praesignis* do not actually belong to that species.

The writer has collected a considerable number of specimens belonging to two species of this genus in the Miyazaki group. One is *A. praesignis* (YOKOYAMA) and found in the Takanabe member. The other is a new species and found in the Boroishi, Tano and Takaoka members. As the writer has already described (SHUTO, 1952) the Miyazaki group ranges from late Middle Miocene to late Early Pliocene in age. The Takanabe member occupies its upper part and is assigned to Lower Pliocene. Therefore the stratigraphic occurrence of *A. praesignis* in this group is quite in harmony with that in other groups of the Pacific side of southwest Japan. The Boroishi and Tano members are the basal conglomerates and the Takaoka member is the lower middle part of the group; they are Upper Miocene in age. Thus in Miyazaki Prefecture, *Amussiopecten* not only occurs in Lower Pliocene but also in Upper Miocene. Yet the genus has not been known from Middle and Lower Miocene.

The writer wishes to express his hearty thanks to Dr. Katura OYAMA of the Geological Survey of Japan for his helpful suggestions and criticisms about the present subject. He is also indebted to Professor Tatsuro MATSUMOTO of the Kyushu University for his guidance, criticisms and encouragement

* *Amussiopecten praesignis* (YOKOYAMA), *A.* ? *yabei* NOMURA and *A.* sp. of OTUKA.

in the course of this study and for reading over the typescript.



Text fig. 2. Stratigraphic Division of the Miyazaki Group.
M. .....member, F.....formation.
X. .....locality of *Amussiopecten*

Systematic Description of Species

Family Pectinidae

Subfamily Amusiinae

Genus *Amussiopecten* SACCO 1897

Amussiopecten praesignis (YOKOYAMA)

Pl. 17, figs. 1 and 3

1922. *Pecten praesignis* YOKOYAMA, pp. 1-2, pl. 5, figs. 1-3.
1926. *Pecten praesignis*, YOKOYAMA, p. 357, pl. 40, figs. 1-2, pl. 41, fig. 1.
1927. *Pecten* (*Amussiopecten*) *praesignis*, MAKIYAMA, pp. 34-36.
1928. *Pecten praesignis*, YOKOYAMA, p. 335.
1929. *Pecten* (*Amusium*) *praesignis*, YOKOYAMA, p. 11.
1930. *Pecten* (*Amussiopecten*) *praesignis*, OTUKA, pp. 507-509.
1931. *Amussiopecten praesignis*, MAKIYAMA, pp. 12-29.
1932. *Pecten praesignis*, NOMURA and NIINO, p. 180.
1933. *Pecten* (*Amussiopecten*) *praesignis*, NOMURA, p. 60.
1934. *Amussiopecten praesignis*, OTUKA, p. 567.
1936. *Pecten* (*Amussiopecten*) *praesignis*, NO-

Table 1. Measurements on the selected specimens of *Amussiopecten praesignis* (YOKOYAMA)

Register Number GK-L—	Locality MI—	Length (mm)	Height (mm)	Depth (mm)	Length of Hinge Line (mm)	H/L (%)	D/L (%)	Hinge/L (%)	No. of Ribs	Apical Angle (degree)	Valve
4370	5595 Toriyama	116.4	106.4	12.2	49.8	91.3	10.4	42.8	16	133	R
4371	„ „	109.1	98.9	10.9	50.7	87.5	10.0	44.8	15	130	L
4372	„ „	76.3	73.6	7.3	37.0	96.3	9.6	48.4	18	123	R
4424	„ „	90.0±			40.0±			44.4	17	125	R
4430	„ „	110.0±			53.4			48.6	18	131	R
4678	„ „	20.7	19.0		12.6	91.7		60.9	16	113	R
4679	„ „	30.4	30.4		16.7	100.0		54.9	16	114	R
4681	„ „	33.7	30.5		16.5±	90.0		49.0	18	113	R
4682	„ „	29.7	28.9	4.2	16.0±	97.1	14.2	54.0	18	114	R
4683	„ „	44.8	44.7	3.5	22.0±	99.5	7.8	49.0	14	114	L
4684	„ „	33.5	31.4		17.7	93.6		52.7	18	115	R
4685*	„ „	57.0±	54.4		30.0±	95.0		53.0	15		L
4686	„ „	111.8	106.0±		54.1	94.0		48.2	15	124	R

* triple ridges on the interior ribs

MURA and ZINBO, p. 247.

1937. *Amusium praesignis*, NOMURA, p. 71.

1938. *Amussiopecten praesignis*, OTUKA, pp. 6-7, pl. 1, fig. 2.

1943. *Amussiopecten praesignis*, SHIKAMA, p. 241, pl. 39, fig. 3.

1952. *Amussiopecten praesignis*, SHUTO, p. 25.

Material.—GK-L 4370-72, 4424, 4427, 4430, 4678-79, 4681-86. All the specimens came from Toriyama, Kawaminami Mura, Koyu Gun*, Miyazaki Prefecture (loc. no. MI-5595).

Measurements.—Shown in the table 1.

Remarks.—The holotype (YOKOYAMA, 1922, pl. 5, figs. 1-3) and other specimens from the Kakegawa group, from which the holotype came, have the characteristic ribs which splits on the marginal part, but the present specimens have the ribs splitting not only in the adult stage but also in the adolescent. This splitting character of the ribs seems to be markedly variable, though original author enumerated it as one of the specific characters. The specimens of the writer's collection from the Tonohama group of Kochi Prefecture are quite identical to the original form, but those from Shimajiri group of Ryukyu at the writer's disposal at the Department of Geology, Kyushu University show the flat ribs without showing any sign of splitting.

Another peculiarity is found in the writer's collection. Though the interior rib of this genus generally has the paired ridges on itself, one specimen before the writer (GK-L 4685) has the interior rib with triple ridges. However the available material is not sufficient enough to clarify the meaning of this pecularity. For the time being it is regarded as one of variations.

Horizon.—Upper horizon of the Takanabe member (Lower Pliocene).

* 児湯郡 川南村 通山.

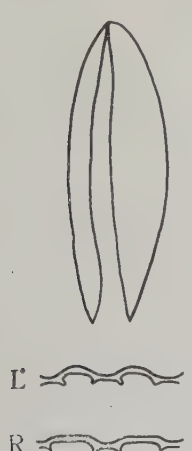
Amussiopecten hyugaensis n. sp.

Pl. 16, figs. 1-5, Pl. 17, figs. 2, 4 and 5, text fig. 3

Material.—Holotype-GK-L 4368, loc. MI-3592; paratypes-GK-L 4150-53, 4155, 4159, 4172, 4364, 4418, 4674, 4676 and 4695.

Measurements.—Shown in the table 2.

Diagosis.—Shell medium to large in size, rather solid, compressed, orbicular in outline, somewhat broader than high, slightly inequivalve. Right valve a little convex, slightly curved near the beak, provided with radial ribs; exterior ribs about 11, low, broad, flat-topped, straight, becoming gradually lower towards the ventral and lateral margin; interstices narrower than ribs themselves; interior ribs wide and flat at the beginning, later becoming concave to have prominent ridges on both sides, and interstices becoming wider near the ventral margin. Concentric lines of growth weak but distinct. Ears subequal; anterior portion being somewhat wavy at anterior border with acute corner and with weak but distinct byssal notch. Left valve planoconvex; ornamented with exterior and interior ribs and growth lines; exterior ribs rather round-topped, as wide as interstices; interior ribs like those on the right valve. Ears equal. Hinge line horizontal, about fourty percent of shell-length in the adult stage.



Text fig. 3. *Amussiopecten hyugaensis* n. sp. Lateral view and rib form in cross section.
L.....left valve, R.....right valve

Comparisons.—The present species is closely allied to *A. praesignis* (YOKOYAMA), but the former has smaller and thicker shell than the latter and is ornamented with less numerous ribs which never split into riblets.

A. ? *yabei* NOMURA, which may be included in *A. praesignis*, is also allied to this new species, but the former has more numerous ribs and large apical angle than the latter.

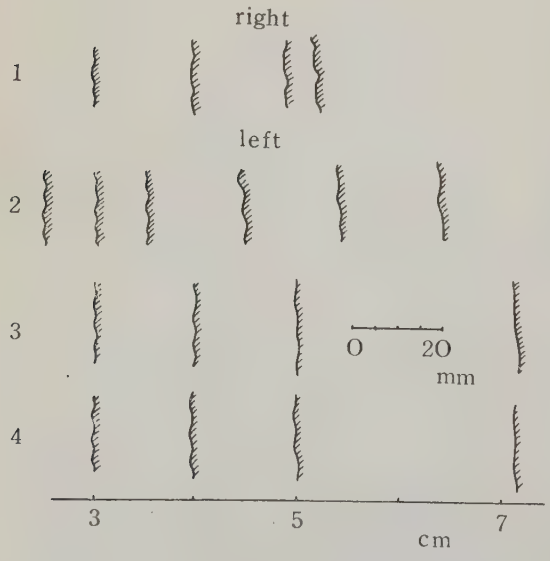
Amussiopecten flavellum UGOLINI (*Flavellipecten pasinii* MENEGHINI), reported from Sardaique, closely resembles the young specimens of the present new species in the general outline and in size, but the former has somewhat more numerous ribs, which are narrower and slightly weaker than the latter.

"*Pecten* (*Vola*)" *sinkirensis* MARTIN has much more numerous ribs, which are rather roof-shaped on the left valve.

Oopecten rotundatus (LAMARCK) is similar to the present species, but is distinguished by its larger size, more convex valves and its ribs are slightly narrower than the interstices. Furthermore the internal ribs are not prominent in the former.

Variation.—As indicated in table 3, this new species is remarkably variable in the size, depth of the valve, number and strength of the ribs etc. The specimens from the lowest horizon attain to 70 mm, those from the middle horizon are less than 50 mm, and those

from the highest horizon are 100 mm or more in the length of the shell. It is neccessary to determine whether or not the larger specimens in each locality are really the adult shells. For the discrimination of this point the relief of the ribs may be useful. The exterior ribs of *Amussiopecten* are distinctly high in relief in young and become lower and obscure as the shell grows. The growth-stage of each individual is not well indicated by size of the shell but by the relief of the ribs at the margin. The ribs are generally almost equal in relief at the shell-margin among the specimens of equal size, regardless of the horizon of the specimens. In other words in the present new species there may be merely the difference in growth stage. Therefore the fact that the size is dissimilar among different localities or horizons may be due to such factors as ecological and sedimentary environments, mode of preservation and or others, although the number of the adult shells are not so numerous as to confirm this interpretation.



Text fig. 4. Relation between the relief of the rib and the size of the shell. Relief is shown in cross section. Hatched part indicates the shell matter. Note that any essential difference can not be observed among three forms.

1-3, *Amussiopecten hyugaensis* n. sp.

4, *A. praesignis* (YOKOYAMA)

Size of the shell is represented by the distance from the beak (scale below).

Relief of the rib is measurable by the scale above.

Concerning the ecology of the following fact should be noted. Apart from the above mentioned difference in size, some other characters also vary by horizon. For instance the specimens from the basal part of the Tano and the Boroishi member show the wide variation in the number and the strength of the ribs, the depth of the valve and the ratio of height to width. Those from the upper part of these members (*Clementia-Paphia* horizon) are rather invariable, the shell of about 50 mm in length, being provided with 11 to 12 ribs of moderate relief and with rather deep valves. Furthermore the shells from the highest horizon attain large size and have the thick shell, the deep valves and the ribs of rather variable number. The lithology of the lower horizon is silty sandstone, coarse sandstone or granule-bearing sandstone and remarkably variable laterally and vertically, and that of the middle horizon is rather monotonous massive silty sandstone or sandy siltstone. In the upper horizon the lithology is again coarse sandstone but is less variable. It has been well known that many Pectinids are the active swimmer and accordingly necessitate much oxigen. Thereupon they favour the coarse

sandy, gravelly or rocky bottom, where water is generally agitated and contains plenty free oxigen. If *Amussiopecten* has similar habit, it is reasonably explained that the large and solid specimens occur in the coarse sediments and the small specimens in the muddy sediments. Much more evidence is required to settle the question.

The variations in the important characters range as follows.

1) The ratio of height to width of the valve varies between 89 and 102 percent and most frequently between 96 and 99 percent.

2) The ratio of depth of the valve to width varies between 11 and 19 per-

Table 2. Measurements on the selected specimens of *Amussiopectem hyugaensis* n. sp.

Register Number GK-L—	Locallity MI—	Length (mm)	Height (mm)	Depth (mm)	Length of Hinge Line (mm)	H/L (%)	D/L (%)	Hinge/L (%)	Number of Ribs	Apical Angle (degree)	Valve
4150	1620 Yusunokihashi	55.4	54.6	2.4	22 ±	98	4	40	11	115	L
4151	903 Kariyabaru	56.0±	58.4	3.3	24 ±	102	6	42	11	103	L
4152	8118 Inohaye	47.5±	45.5±	3.5	24.4	96	7	51	10	117	L
4153	8118 Inohaye	39.7	39.0	7.4±		98	19		11	117	R
4154	8118 Inohaye	20.0±	19.0±	3.4±		95	17		11	108	R
4155*	903 Kariyabaru	50.5±	47.5			94			11	118	L
4156	2470 Maruno	33.7	33.5	4.7		99	14		14	115	R
4157	3189 Obira	36.0±	33.0±	4.1	15.2	92	11	42	13	115	R
4159	3189 Obira	43.0	41.0±			96			12	116	L
4161	826 Horiguchi		30.3	3.2					10	115±	R
4162	826 Horiguchi	24.0±	23.5			98			11	111	R
4164	157 Kano	20.5	20.0±	3.3		97	16		12	112	R
4168	2698 Iyeichigo	17.4	17.0±	2.0		98	12		10	112	R
4169	3121 Hokobo	18.5±	17.0±			92			11	108	L
4170	2610 Kagamisu	22.3	21.4	3.2		96	14		11	111	R
4176	743 Yanaze		74.0±						14		R
4177	1615 Yusunokihashi	85.0±							13	129	R
4178	437 Mokudo	44.0±							14	115	R
4180	437 Mokudo	56.0±	54.0±			96			10	113	R
4181	2610 Kagamisu	32.2	28.6			89			11		L
4182	525 Morinaga		60.0±						15		L
4184	1620 Yusunokihashi	27.8	27.3			98			11	114	R
4185	839 Horiguchi	27.4	24.8	4.8		91	17		14	115	R
4186	161 Akatani	28.4	25.6			90			12	112	R
4187	3121 Hokobo	33.1			17.4			52	11	117	L
4189	903 Kariyabaru	23.4	23.7			101			11	112	L
4191	903 Kariyabaru	24.5	22.0±			90			13		L
4192	903 Kariyabaru	22.2	22.0±			100			12		L
4194	903 Kariyabaru	23.2	22.4	1.9	13.9	96	8	60	11	111	L
4195	3121 Hokobo	19.6	19.1			97			12	107	L
4349	1334 Haigano	14.2	13.9			98			11	113	L
4351	1334 Haigano	14.3	13.9			97			10	108	L
4364	3592 Oyamada	30.9	30.1	4.2	16.7	97	13	54	13	117	R
4365	3592 Oyamada	42.3	41.3	7.9		97	19		11	117	R
4366	3592 Oyamada		39.7	2.1	19.3				11	119	L
4368	3592 Oyamada	103.0±	101.7	19.0**	48.0±	99	18**	47	11	122	L
4369	3592 Oyamada	100.0±	99.0±			99			11	127	L
4421	3121 Hokobo	19.4	19.3			99			12	114	L
4671	3592 Oyamada	30.1	27.7	3.9	13.1	98	13	44	12	110	R
4672	3592 Oyamada	58.0±	55.4	5.4	24.5	96	9	42	11	118	L
4675	3592 Oyamada	35.1	32.3	6.9		92	19		12	115	R
4676	3592 Oyamada	24.4	22.9	3.9	12.4	94	16	51	11	111	R
4677	3592 Oyamada	108.0±	107.0±			99			11	125	L

* conjoined and deformed. ** thickness of conjoined valves.

cent, and most frequently between 12 and 17 percent in the right valve; between 4 and 8 percent in the left.

3) The ratio of hinge-line to shell-length varies between 40 and 50 percent in the adolescent and adult shells, but the young specimens show larger value, for example, it is 60 percent in a specimen whose shell-length is 23.2 mm.

4) Apical angle varies between 103 and 129 degrees and most frequently between 110 and 117 degrees in the adolescent shells and between 122 and 127 in the adult.

5) The number of the exterior ribs varies between 10 and 15, and most frequently between 11 and 12.

Horizon.—Lower part of the Miyazaki group (late Middle Miocene to middle Upper Miocene).

Locality.—Waritsuke and Mokudo, Aya Machi*; Morinaga, Honjo Machi**; Yanaze, Akatani and Kano, Takaoka Machi***; Yusunokihashi and Oyamada, Mukasa Mura****; Kariyabaru, Haigano, Hokobo, Horiguchi and Obira, Tano Machi*****; Iyeichigo, Maruno and Kagamisu, Miyazaki City******; Inohaye, Kitago Mura*******.

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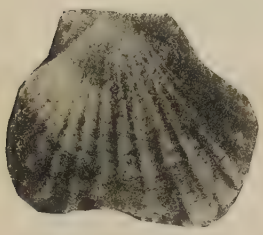
Explanation of Plate 16

Figs. 1-5. (×1), *Amussiopecten hyugaensis* n. sp.
1, right valve, paratype, GK-L 4163, loc. MI-157.
2, left valve, paratype, GK-L 4696, loc. MI-903.
3, left valve, holotype, GK-L 4368, loc. MI-3592.
4, left valve, paratype, GK-L 4151, loc. MI-903.
5, left valve, paratype, GK-L 4152, loc. MI-1620.

Explanation of Plate 17

Fgis. 1 and 3. *Amussiopecten praesignis* (YOKOYAMA)
1, (×1), right valve, GK-L 4682, loc. MI-5595.
3, (×5/6), left valve, GK-L 4371, loc. MI-5595.
Figs. 2, 4 and 5. (×1), *Amussiopecten hyugaensis* n. sp.
2, right valve, paratype, GK-L 4364, loc. MI-3592.
4, left valve, GK-L 4152, loc. MI-8118.
5, left valve, inner cast, GK-L 4159, loc. MI-2198.



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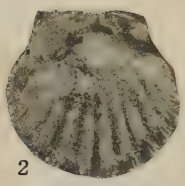

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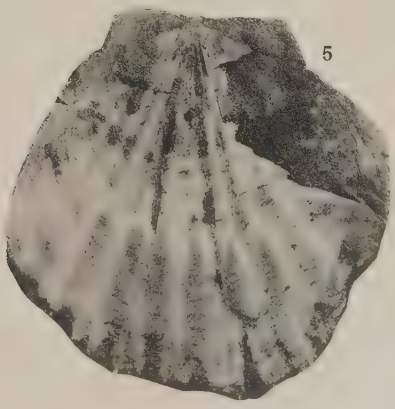

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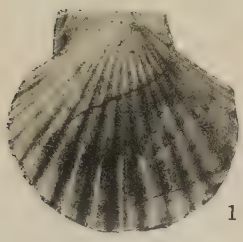

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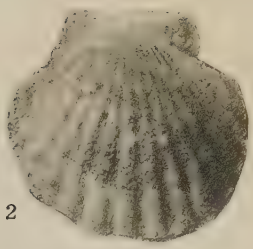

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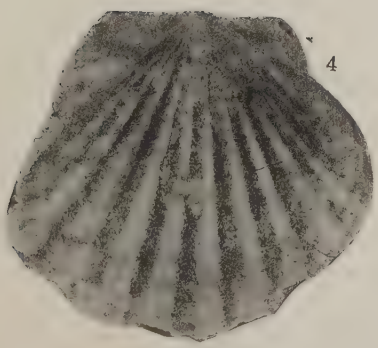

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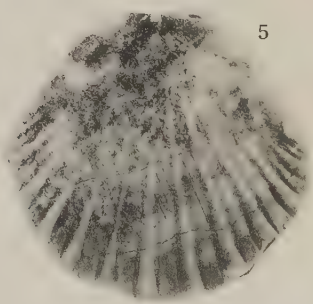

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Photos by T. Shuto

Trans. Proc. Palaeont. Soc. Japan, N. S, No. 20, pp. 111-118, Pl. 18, Dec. 30, 1955

277. LES AMMONITES RECUEILLIES DANS LE GROUPE DE KURUMA, NORD DU JAPON CENTRAL*

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来馬層群より産出した菊石について： 来馬層群の時代は確実に決められていなかつたが，大平川支流の寺谷から *Amaltheus* sp. indet., Aff. *Deroceras* sp. indet., *Canavaria* sp. ex gr. *geyeriana* (HAAS) を産出したので，一部は Domerian であることが分つた。 佐藤 正

Introduction

La série de Kuruma s'étend dans la Nord partie du Japon central, notamment sur la région frontière des Préfectures de Niigata et de Toyama, mais la succession des couches de cette série était à peine établie, puisque les fossiles indicateurs et les assises caractéristiques n'y ont pas été découverts. Toutefois, plusieurs auteurs ont exploré cette region et récolté beaucoup de fossiles paraliques et néritiques, qui sont très abondamment concentrés dans quelques horizons, mais ne sont pas étudiés en détail. Les fossiles végétaux ont aussi été trouvés; l'âge rhétien est indiqué par cette flore. Cependant, l'on ne pouvait pas exactement préciser l'âge de cette série d'après ces seuls fossiles. Dans une période ancienne, quelques géologues ont trouvé à la rivière de Daïra des Ammonites qui sont en tout cas incomplètes et non identifiable génériquement.

En 1952-54, beaucoup de spécimens d'Ammonites ont été trouvés dans la vallée de Teradani, une branche de la Daïra, qui est située à la partie Est de la Préfecture de Toyama, au Nord du Japon central. Les Ammonites ont été récoltées dans une assise assez mince, et sont remarquablement concentrées.

Toute la gratitude de l'auteur va en particulier à M. le Professeur T. KOBAYASHI qui, le premier, a fait lui connaître le gisement d'Ammonites dans cette région et le surveillé pendant son étude. L'auteur remercie M. le Docteur P. L. MAUBEUGE qui l'a donné beaucoup de critiques et a corrigé son manuscrit, et aussi M. le Professeur T. MATSUMOTO, Université de Kyushu, qui l'a enseigné des faits sur le Groupe de Toyora. MM. K. KONISHI, M. TAMURA et G. MORI ont récolté beaucoup de spécimens dans la vallée de Teradani avec l'auteur, à qui ses remerciements vont particulièrement.

Géologie en sommaire

Le Groupe de Kuruma est composé de couches très épaisses, contenant plusieurs assises de grès, d'argiles et de conglomérats, dont l'épaisseur est d'environs 6.000–7.000 mètres. A la partie presque médiane de cette série se trouvent les couches marines, d'où les Ammonites proviennent. Elles sont plus ou moins minces, composées d'argiles massives et

* Read Oct. 29, 1955, received July 23, 1955.

de grès aussi massifs, riche en fossiles marins.

L'assise dans laquelle les Ammonites et les Bivalves marins ont été trouvés, affleure dans la vallée de Teradani, où on constate trois zones d'Ammonites ou plus, et aussi dans la vallée de Kanayamadani. Cette assise s'appele la "Formation de Teradani". L'extension de cette assise est reconnu dans la vallée d'Itsumba vers l'Ouest, et vers l'Est dans la vallée de Kanayamadani, Préfecture de Niigata, mais il est impossible de reconnaître sa limite Ouest.

Les Ammonites, différentes de celles de la Formation de Teradani, ont aussi été trouvées dans la vallée d'Otakidani, mais elles sont trop mal conservées pour une identification.

Âge

La faune de Teradani est composée des Ammonites des genres: *Amaltheus*, *Deroceras*, *Canavaria* et *Phylloceras* et de Pélécypodes marins. *Amaltheus* se trouve dans le Domérien nord-européen, et notre espèce est très proche d'une forme d'*Amaltheus*, qui est connu au Lias delta inférieur, c'est-à-dire à la zone à *depressus*, dans l'Allemagne S-E et au Pliensbachien supérieur de l'Angleterre. Donc, l'âge de cette assise semble un peu plus ancien que le Domérien. *Amaltheus* se cantonne dans le Lias delta des régions européennes.

Deroceras est malheureusement recueilli en débris, dont la roche est peut-être originaire d'une zone indépendante. Il se trouve dans l'Europe au Pliensbachien inférieur. *Canavaria* est très abondamment recueilli dans cette localité, et joue un rôle très important dans la corrélation stratigraphique; il se trouve dans le Domérien de la région méditérranéenne. Donc, la Formation de Teradani, une partie de la série de Kuruma, ont été déposées pendant le Pliensbachien (supérieur ?).

Description des Espèces

Canavaria sp. ex gr. geyeriana (HAAS)

1913. *Harpoceras* (*Arieticeras*) *retrorsicosta* OPPEL var. *geyeriana*, HAAS, *Lias von Ballino*, p. 63, Tav. 11, Figs. 10, 12 non 11.

1931. *Canavaria geyeriana*, FUCINI, *Foss. domer. dintorni Taormina*, p. 154, Pl. 16, Figs. 11-13.

Diagnose:—Coquille discoïde, sa section est quadrangulaire chez la spire jeune, puis moins épaisse chez l'adulte (stade d'environ 10 mm de la hauteur du tour), devenant plus elliptique. Tours nombreux, peu embrassants (1/5 du tour précédant), la croissance du tour un peu rapide. Chute du tour sur l'ombilic inclinée et convexe; le bord ombilical est arrondi mais l'aspect de cette région est à peine reconnue chez les jeunes de notre collection.

L'ornementation varie avec l'acroissement de la spire. Jusqu'à la hauteur d'environ 2 mm de tour, le ventre est orné de la carène arrondie et obtuse. Au stade de 2 mm à 7 mm environ de la hauteur de tour, la carène ventrale haute, épaisse, mais arrondie est bordée de sillons assez profonds et très étroits. Les côtes sur le flanc sont droites, élevées, et arrondies, se terminant aux tubercules qui sont petits et absents au stade adulte, ou déformés sur quelques échantillons. De ces tubercules, naissent les côtes accessoires qui sont très faibles, dirigées en avant, sont inclinées de façon abrupte, et quelquefois une sorte de faible carène près de sillons. Ce stade se continue en principe au diamètre de 5–6 mm, mais c'est plus ou moins variable. Dans l'autre cas, le sillon n'est pas

né, mais la carène se distingue nettement de la région ventrale. Au stade suivant, qui est de 7–15 mm environ de la hauteur de tour, le sillon a disparu, mais la carène reste arrondie et épaisse, dépassant nettement de la région ventrale; mais dans quelques cas, la carène est encore bordée du sillon rudimentaire. Les côtes sont invariablement droites, terminées aux petits tubercules qui sont disparus au stade adulte. Section du tour plus comprimée et elliptique. Le ventre semble généralement arrondi. Quand les tours deviennent plus grands, le ventre est complètement arrondi. Mais il est impossible de constater le caractère adulte, parce que l'on ne peut pas trouver un bel exemplaire dans notre collection. Bouche inconnue. Ligne suturale inconnue.

Dimensions :—en mm.

Numéros	Diamètre	Diamètre de l'ombilic	Hauteur	Epaisseur
T5303-12	23 7	10,5	8,2	?
T5303-36	68,3	30,5	21,5	?
T5303-45	ca 75	31,5	25,0	6,5
T5303-46	62,5	27,5	20,5	6,5
T5303-79	36,0	17,0	12,0	10,3

Observation :—L'ornementation de la coquille change d'autant plus que le stade d'acroissement s'avance. En particulier, les tubercules ont disparu à un stade remarquablement différent, avec celui l'absence du sillon. Les tubercules ne sont pas visibles sur toutes les formes de plus 20 mm de hauteur du tour, mais il y a un groupe où ils manquent au stade moins haut. Au tour haut de 7–8 mm, les tubercules peuvent être nettement reconnus; le stade de disparition des tubercules est tardif (à environ 10 mm de la hauteur). Sur les tours, T5303–37, T5303–45, T5303–54, le ventre est aigu, dépourvu de carène. Sur une spire d'un spécimen (T5303–45) les côtes sont plus serrées et plus faibles. Parce que cette variation n'est pas visible sur plusieurs des autres échantillons, elle ne semble peut-être pas représenter une variation.

Affinité et Comparaison :—Cette forme provenant abondamment de la Formation de Teradani est aparemment proche de *Canavaria* Gemmellaro, jugée par son ornementation de la spire. La carène assez obtuse mais haute, les deux sillons près de celle-ci sur la région ventrale, qui sont peu profonds mais bien distincts de la région ventrale, les tubercules de chaque côte sur la région périphéro-latérale, les inflexions des côtes vers l'avant sur la région périphéro-latérale : tout cela indique les caractères de *Canavaria*. Bien que les cloisons ne soient pas reconnues, l'auteur n'hésite pas la rapporter à *Canavaria*.

Les deux spires de tubercules ont donné naissance sur la partie la plus interne et sur la partie périphérique des côtes chez les plusieurs espèces de *Canavaria;* mais il y a un groupe pourvu d'une ligne de tubercules, (*C. geyeriana* représente ce groupe), auquel notre forme peut être rapportée.

Dans la région méditérranéenne il y a plusieurs genres très semblable à ce genre; *Emaciaticeras* en est surtout le plus proche. Il est orné des côtes similaires, contenant des espèces quelquefois pourvues de tubercules petits sur la partie périphérique au stade jeune, qui tend à disparaître plutôt. Mais Fucini ne précisa pas les distinctions pour la création de ce genre et la

naissance de tubercules comme caractère générique n'est pas non plus donnée; mais cela suggère l'affinité très intime de deux genres. *Seguentia,* inclus parmi *Arieticeras* par les auteurs anciens, semble proche de cette espèce de Teradani. Mais il est aisément distinguable par la réunion des côtes sur le flanc interne, par la disparition de l'ornementation sur la partie intérieure du flanc. *Arieticeras,* un représentant de ce groupe d'Harpoceratidé, en diffère par les détails suivants: les côtes flexeuses, la carène très haute et mince et la disposition plus espacée des côtes sur le flanc.

Position stratigraphique:—C. geyeriana a recueilli au Domérien de Kratzalpe et de Taormina. Mais les formes douteuses sont citées à Medolo, Brianza, Spezia et dans l'Appenin central dans le Lias moyen d'après HAAS. Mais dans cette région, les zones d'Ammonites n'ont pas été précisées et l'on ne peut pas reconnaître le niveau correct de cette forme; par conséquent, l'auteur veut le rapporter à l'âge domérien ou au Lias moyen.

Aff. *Deroceras* sp. indet.

Diagnose :—Coquille discoïde, peu embrassante; spire croissant plus ou moins lentement, composée de 4 tours, à la section quadrangulaire et convergente, au flanc très étroit et un peu renflé, à la région ventrale très étendue et arrondie, dépourvue de carène. Ombilic très ouvert, large; chute du tour sur l'ombilic très inclinée et son bord arrondi.

2 spires les plus internes lisses et arrondies. Troisième tour orné des côtes sur le flanc très obtuses et assez distantes, qui ont donné naissance au bord ombilical et deviennent plus saillantes contre la région ventrale, et pourvues de tubercules très épineux, qui tendent à prolonger dans la direction du rayon. Ces tubercules sont disposés de la même manière sur deux flancs, et la région ventrale est ornée des côtes plus fines et plus nombreuses que celle sur le flanc. Cettes côtes obtuses et fines sont disposées asymétriquement de telle sorte que deux épines disposés sur la region périphérale sont réunies par les diverses côtes. Ligne suturale inconnue.

Dimension :—

Diamètre, 15,7 mm; Diamètre de l'ombilic, 7,9 mm; Hauteur, 4,3 mm; Epaisseur, 4,6 mm

Affinité :—Nous avons un seul échantillon. Il semble qu'il appartient à *Deroceras,* bien qu'il ne présente qu'un stade très jeune. Il est très proche de la série de *Bifericeras-Deroceras,* mais l'auteur ne peut pas le rapporter sûrement à *Bifericeras,* parce que la désignation originelle ne cite pas l'ornementation ventrale de *Bifericeras.* Jugée sur les quelques figures citées, elle est formée des côtes indivisibles, au contraire du groupe de *planicosta* qui a l'ornementation des côtes bifurquées sur la région ventrale; donc, on peut le rapporter plus aisément comme un membre d'une branche de *Deroceras.* On ne peut pas décider son espèce puisqu'il manque les tours adultes. Mais il faut remarquer les deux ou trois tours qui sont tous lisses et arrondis. Il faut aussi noter la ressemblance pour le stade jeune d'*Arietites coregonensis* WÄHNER, mais celui-ci a les tubercules allongés radialement; en particulier, il y a une tendance à l'abaissement des côtes vers la suture ombilicale chez ce spécimen recueilli à Teradani. Parce qu'il manque les tours adultes, il est préférable de ne pas conclure sur sa position systématique.

Amaltheus sp. indet.

Diagnose :—Coquille discoïde, plus ou

moins plate, assez profondement embrassante. Tours à section elliptique, mais très plate, avec l'épaisseur maxima sur le milieu du flanc. Ombilic très étroit et bas. Chute du tour sur l'ombilic inclinée chez la spire jeune, mais verticale chez l'adulte. Ventre plus ou moins aigu et pourvu de la carène.

Côtes très obtuses mais assez élevées sur le flanc, disposées radialement, les plus élevées près du bord ombilical, puis s'abaissant sur la région ventro-latérale, pour se diriger en avant. Par conséquent, la région ventro-latérale est presque lisse, surtout sur la spire assez âgée. Les côtes, moins élevées et plus nombreuses que celles sur le flanc, passent sur le ventre aminci, sans aucune interruption et sans aucun faiblissement au milieu du ventre, en formant la carène crénelée qui n'est pas distinguée nettement de la région ventro-latérale. Quelques côtes continuent de la suture ombilicale à la région ventrale.

Ligne suturale profondement découpée. Lobe ventral bifide et pourvu de deux lobules latéraux. Selle ventrale très haute, vide, étroite à la base, et divisée par les trois lobules. Lobe latéral supérieur plus profond que le ventral, plus ou moins vide, et profondement bifurqué : la branche interne est toujours plus longue et plus nettement découpée que l'externe. Lobes et selles latéraux inférieurs et auxiliaires sont tous petits et, graduellement, décroissent contre le bord ombilical.

Observation :—Nous avons 6 échantillons trouvés dans la même localité, mais trois sont si mal conservés qu'ils ne pouvent pas être utilisés pour une identification. Tous nos échantillons sont plus ou moins déformés par la pression de la roche d'où ils proviennent (excepté un exemplaire) et sont ainsi aplatis. Sur le moule interne de la spire du spécimen typique reste un fragment de la coquille, qui est orné de stries fines dirigées radialement. Ce caractère est reconnu sur le moule interne d'autres échantillons. Sur le spécimen typique les côtes ne continuent pas de la région ombilicale à la région ventrale, mais elles le font souvent sur les autres échantillons. Il apparaît que l'on peut reconnaître une carène vraisemblable sur quelques parties de la spire. Mais l'absence de la carène vraie est prouvée par l'ornementation de la région ventrale chez les stades adultes du spécimen typique. Ce caractère est visible chez quelques exemplaires d'*Amaltheus*, d'après Wright et Frentzen.

Comparaison et Affinité :—Cette espèce apparaît être très proche d'*Amaltheus depressus*. La disposition des côtes et l'involubilité de la spire de cette espèce suggère l'affinité du stade *compressus* d'après Frentzen (tandis que le genre *Amaltheus* par Frentzen comprend les espèces qui appartiennent obligatoirement à *Paltopleuroceras*), mais on ne peut pas négliger des caractères assez importants qui diffèrent entre les deux formes. Quelques-uns des exemplaires cités dans les planches de Frentzen, 1937, Taf. I, Fig. 28; Taf. II, Fig. 17, présentent le même aspect de la région ventrale, tel que la carène ne se distingue pas de la région ventrale; tandis qu'elle n'existe qu'à quelques stades de la croissance, l'on ne peut pas reconnaître un beau développement de la

Dimensions :—en mm.

Numéros	Diamètre	Diamètre de l'ombilic	Hauteur	Epaisseur
T5303-1	35,3	9,5	15,6	ca 6,5
T5303-1a	43,0	10,5	20,5	?

carène chez quelques-uns de nos échantillons. Ainsi, l'aspect de la même manière est trouvé sur *Amaltheus clevelandicus* (figuré par BUCKMAN; Type Ammonites, Pl. CIX, Figs. 1, 2) mais il diffère de notre forme très nettement par l'ornementation beaucoup plus forte sur le flanc. Ce caractère s'accompagne de la disparition des ornements sur le flanc chez les spécimens de l'Allemagne SO, au stade d'*engelhardti* d'après FRENTZEN, Taf. II, Fig. 19; en outre, notre spécimen montre que les ornements sur le flanc tendent à disparaître avec plus de retard que la carène.

De plus, WRIGHT a représenté la forme ornée de la même manière sur la région ventrale, Taf. LVI, Fig. 15, sans donner la vue périphérique. Cependant, l'auteur ne peut pas reconnaître les spires internes et les tubercules généralement apparus chez le stade jeune. Il semble que les formes de notre collection, celles de FRENTZEN et de WRIGHT, tandis que proche au stade comparable, se différencient assez distinctement. La ligne suturale est moins découpée que les formes citées par FRENTZEN et autres. Le lobe latéral supérieur n'y est pas bifurqué, et le tronc en est assez profond et vide; le lobe latéral inférieur y est plus petit que celui de cette espèce. Mais son arrangement est fait en principe de la même manière que *depressus*, et le dégré d'incision est très ressemblant. L'auteur veut décrire cette espèce comme une affinité d'*Amaltheus depressus*.

BUCKMAN a décrit quelques espèces d'*Amaltheus* dans "Type Ammonites"; *Amaltheus sedwickii* (Pl. CXXV) et *A. depressus* (Pl XXV, Figs. 1, 2) sont très ressemblants à notre espèce. Mais l'on ne peut pas constater les cloisons et l'aspect ventral de celui-là, et les cloisons de celui-ci; donc, l'auteur ne pouvait pas exactement les rapporter à notre forme, tandis qu'ils semblent très proche de notre forme en général.

Il est nécessaire de remarquer que *Proamaltheus* établi par Lange en 1932 est ressemblant à cette espèce, mais il en diffère par l'absence de côtes aussi fortes que celle de notre espèce, et par la présence des fines stries sur la région ventrale.

Cette espèce a une ressemblance plus ou moins nette avec quelques formes du genre *Aegoceras*, qui a la section généralement arrondie. Par exemple, *Discamphiceras* est ressemblant à notre espèce (WÄHNER, Taf. XXV, Figs. 6a, b, c); mais les côtes ventrales tendent à s'y abaisser au milieu de la région ventrale. Cette tendance représente son affinité avec *Schlotheimia*. Et sa ligne suturale est très différente, qui a 4 lobes et selles latérales inférieures et auxiliaires; et elles décroissent beaucoup plus rapidement contre le bord ombilical.

Position stratigraphique :—Amaltheus n'est trouvé qu'au Lias moyen, notamment Lias delta, dans la région européenne et méditérranéenne. Notre forme semble aussi domérienne. A Nagato, M. le Professeur MATSUMOTO a recueilli un spécimen ressemblant à notre collection, avec association d'un individu ressemblant à notre *Canavaria* (Communication personelle). Ils sont très fragmentaires, tels que la determination est impossible. Si les formes sont aussi *Canavaria* et *Amaltheus*, l'âge de la Formation de Higashinagano de laquelle ils proviennent, est problematique, puisque une assise susajacente est déterminée comme du Domérien par M. le Professeur MATSUMOTO.

Outre cettes espèces, quelques exemplaires très fragmentaires et mal conservés, qui sont vraisemblablement

proche des Phylloceratidés et des Lytoceratidés, ont été recueillis dans la même localité de Teradani. Ces exemplaires seront décrits après la récolte de meilleurs spécimens.

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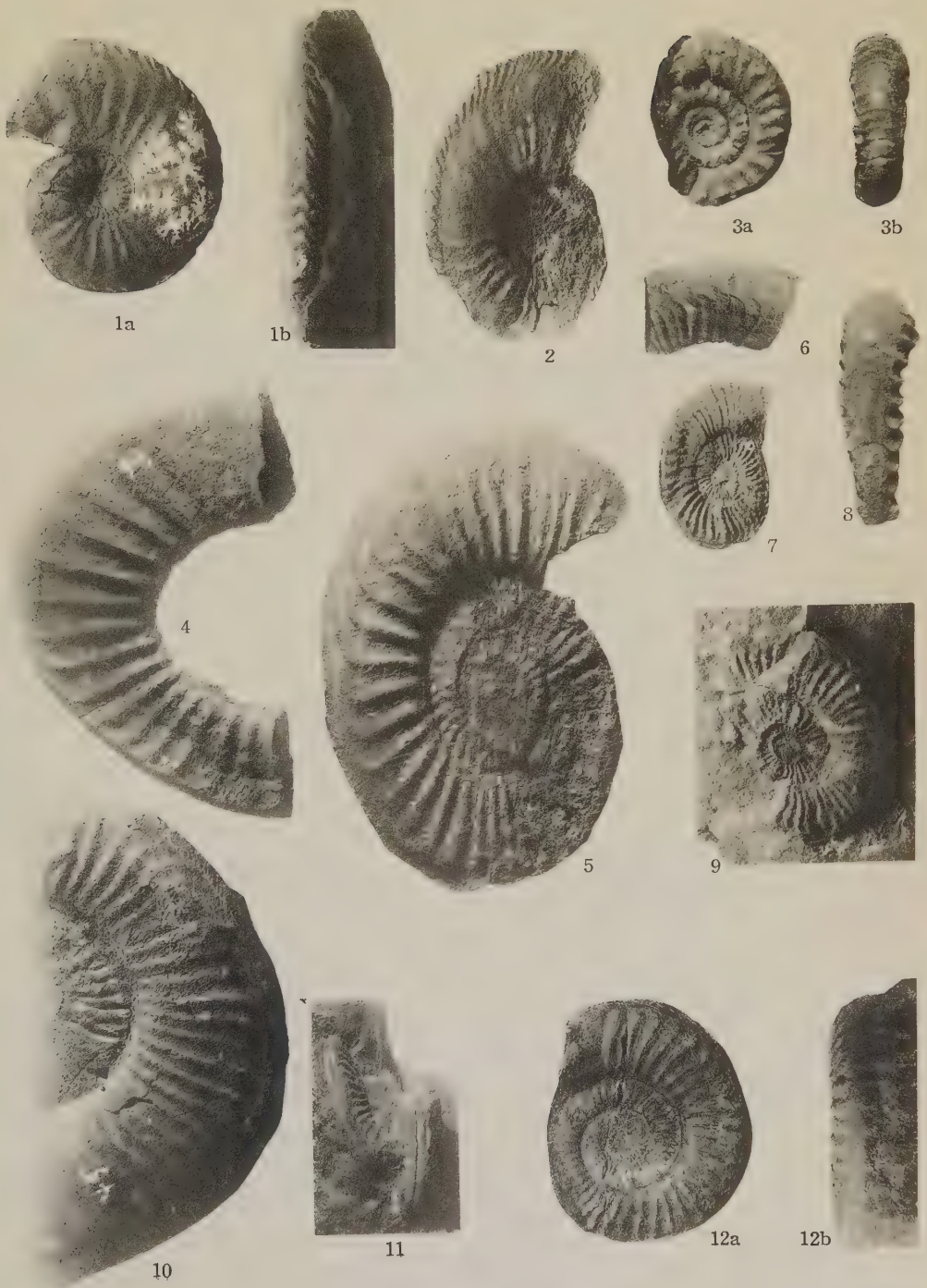
Explication de la Planche 18

Amaltheus sp. indet. ..... p. 114
Fig. 1a. T5303-1, vue latérale, Loc. 5303, ×1
Fig. 1b. Vue périphérique du même spécimen que 1a, ×1
Fig. 2. T5303-1a, vue latérale, Loc. 5303, ×1
Aff. *Deroceras* sp. indet. ..... p. 114
Fig. 3a. Vue latérale, Teradani (dans le débris), ×2
Fig. 3b. Vue périphérique du même spécimen que 3a, ×2
Canavaria sp. ex gr. *geyeriana* (HAAS) ..... p. 122
Fig. 4. T5303-46, vue latérale, Loc. 5303, ×1
Fig. 5. T5303-36, vue latérale, Loc. 5303, ×1
Fig. 6. T5303-81, vue périphéro-latérale, Loc. 5303, ×1
Fig. 7. T5303-12, vue latérale, Loc. 5303, ×1
Fig. 8. T5303-82, vue périphérique, Loc. 5303, ×1
Fig. 9. T5303-25, vue latérale, Loc. 5303, ×1
Fig. 10. T5303-45, vue latérale Loc. 5303, ×1
Fig. 11. T5303-80, vue périphérique, Loc. 5303, ×1
Fig. 12a. T5303 79, vue latérale, spécimen typique, Loc. 5303, ×1
Fig. 12b. Vue périphérique du même spécimen que 12a, ×1


1a
1b
2
3a
3b
6
8
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12a
12b

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278. MIOCENE MOLLUSCA FROM NOTO PENINSULA, JAPAN. PART 1. (I)*

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能登半島の中新世軟体動物；その 1, (I). 筆者は既に，能登半島北部の石川県輪島市東部・鳳至郡町野町・柳田村附近に発達している新第三系の地質について報告したが，今回，東印内層から採集した貝化石について考察した。その結果，東印内層が純海成及び汽水成の堆積相よりなることを明かにした。更に町野町徳成より採集した化石の中，12 新種と 1 新亜種を記載したが，紙面の都合上本編では，二枚貝 4 種と巻貝 1 種の記載を掲げた。 増田孝一郎

Introduction and Acknowledgements

In the present article, are treated the Miocene molluscan fossils collected from the Higashi-Innai formation developed in Machino-machi and Yanaida-mura, Fugeshi-gun, and Najimi, Wajima-shi, Ishikawa Prefecture in the northern part of Noto Peninsula, Japan. The majority of the specimens studied are now preserved in the collection of the Department of Geology, College of Education, and the minority in the collection of the Institute of Geology and Paleontology, Faculty of Science, both of the Tohoku University in Sendai. The Cenozoic Mollusca in the collection of the Institute of Geology and Paleontology, Tohoku University and of the Saito Ho-on Kai Museum in Sendai were used for comparative work with the fossils from this region.

Acknowledgements are due to Dr. Kotora HATAI of the Department of Geology, College of Education, Tohoku University, for his kind supervision, and to Dr. Kiyoshi ASANO of the Institute of Geology and Paleontology, Faculty of Science, Tohoku University, for his encouragement and advice. Thanks are also due to Mr. Akio HAMADA, teacher of the Najimi Middle School at Najimi, Wajima-shi, for his assistance in collecting specimens.

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Geological Notes

The stratigraphy of the Tertiary strata developed in this region was previously published by the writer (1954), who recognized the following formations, in ascending order:

Kônosuyama volcanics: Andesite, basalt, dacite and their agglomerates, and diorite. Part of the diorite is younger than the volcanics. Their stratigraphic sequence is unknown.

—(stratigraphic relation uncertain)—

Tokunari formation: Pumiceous tuff and brecciated tuff with lenticular layers of tuffaceous sandstone, tuffaceous mudstone and conglomerate. These rocks

are intercalated between the flows of andesite, basalt and dacite. This formation probably interfingers with the Kônosuyama volcanics, though their contact was not seen.

(unconformity)

Higashi-Innai formation: Mudstone, siltstone, sandstone and conglomerate from the upper to the lower, in which lignite is intercalated. Mollusca and Foraminifera abundant.

Awagura formation and Iwakurayama rhyolite: The former comprises finely stratified white or light green colored pumiceous tuff, brecciated tuff and sandy tuff. The Iwakurayama rhyolite eruption took place during deposition of the Awagura and is responsible for the large quantities of tuff.

Najimi formation: Tuffaceous mudstone and tuffaceous siltstone, locally with pumiceous layers and laminated tuffaceous sandstone layers. Molluscan shells and sponge spicules occur throughout the formation. In the northern part of the area, Radiolaria and *Globigerina* are common and *Conchocele* is the outstanding megafossil. In the southern part of the area, Foraminifera are abundant and *Globigerina* is also found. The common occurrence of *Globigerina* suggests a free connection with the open sea.

(unconformity)

Ôkawa terrace deposits: Sand, gravel and clay. Fossils not found.

The fossils dealt with in this article were collected from the middle or lower part of the Higashi-Innai formation. From the fossil locality of Tokunari, the most important of the Higashi-Innai formation, the writer has identified 37 species in total among which 13 species are new to science. Further, several genera are recorded for the first time from the Miocene or Cenozoic rocks of Japan.

The Higashi-Innai formation shows lateral change in lithological facies and contains rocks of marine and brackish-water facies. Although there are many fossil localities of this formation, only those from the sandy mudstone containing much carbonaceous matter at Tokunari, Machino-machi, Fugeshi-gun (lat. 37°24′36″N., long. 137°05′20″E.) are well preserved; these are described in this article.

Notes on the Paleontology

The fossil fauna in the vicinity of Tokunari compared with those from other localities consists of specimens with intact valves, which are well preserved and little water-worn shells were found. This fact indicates that the fauna probably lived in the environment in which it was buried, at least it can be inferred that it was not subject to transportation from a remote place. Therefore, the said fauna may represent a biocoenose. It is also worthy to mention that the brackish water genera as *Vicarya*, *Viçaryella*, *Cerithidea* and *Batillaria* do not occur in association with *Operculina*, *Miogypsina* and smaller foraminifers, although they can be inferred to the same stratigraphic horizon. These facts suggest that during deposition of the formation, both pure marine and brackish water environments existed at the same time but at different places, and that the latter environment may have been one of an embayment.

From the faunal elements of the Higashi-Innai formation it is evident

that deposition proceeded under the influence of warm and shallow water conditions. It is also inferred from the stratigraphic relationship of the megafossils to the smaller foraminifers previously reported by K. ASANO (1953), that during the initial stage the Higashi-Innai formation was under the influence of shallow waters, but by progressive development, the seas gradually became deeper towards the upper part of the formation.

The occurrence of *Vicarya*, *Vicaryella* and other fossils given in the list indicate that the age of the fauna of the Higashi-Innai formation is Early Miocene, more precisely lower Middle Miocene in age.

The distribution of the respective fossils given in the list show that the Higashi-Innai formation can be considered to be a correlative of the fauna of the Meisen formation of Korea, the Fujina of Shimane Prefecture, the Yatsuo of Toyama, the Nishikurosawa of Akita, the Shôbara of Hiroshima, the Tsuyama of Okayama, and the Tsukiyoshi formation of Gifu Prefectures. From such a correlation it is evident that the warm seas of that age were rather extensive in distribution.

Description of New Species

Family Veneridae

Genus *Callista* POLI, 1791

Callista chinensis takagii MASUDA, n. subsp.

Pl. 19, fig. 7.

Shell small in size, rather thin, moderately inflated, transversely elongated; surface ornamented with fine, numerous concentric growth lines; beak moderately swollen, bluntly pointed and situated at about posterior one-third of shell length. Antero-dorsal margin gently sloping into rounded anterior side; postero-dorsal margin longer than anterior, gently sloping into rounded posterior side; ventral margin broadly rounded. Dimensions (in mm.):–Height 13.0, length 21.5 (holotype), height 12.0, length 19.3 (paratype).

Occurrence:—Few.

Depository:— DGS*, Reg. No. 2501 (Holotype).

Remarks—The specimens are characterized by their little inflated shell, rounded anterior end and narrow posterior end, and the position of the beak. *Callista chinensis* (HOLTEN) (HIRASE, 1951, pl. 34, fig. 7), a common Recent shell of Japan, is distinguishable from the present species by the less inflated beak, broader anterior side, longer postero-dorsal margin, higher shell and more compressed aspect.

This species is named in honor of Mr. Magokichi TAKAGI who helped the writer in the field.

Genus *Clementia* GRAY, 1847

Clementia japonica MASUDA, n. sp.

Pl. 19, fig. 8.

Shell moderate in size, thin, transversely elongated, inequilateral; postero-dorsal margin nearly straight, posterior end sharply rounded; antero-dorsal margin shorter than the posterior, forming concave arc with beak, its end regularly rounded; ventral margin broadly rounded. Beak moderately inflated, directed forwards, small, not touching. Surface sculptured with coarse concentric waves and fine concentric threads, both irregularly spaced; waves tend to become obsolete

* DGS=abbreviation for Department of Geology, College of Education, Tohoku University, Sendai, Japan. This abbreviation will be used throughout in this paper.

near the margin. Escutcheon obscure. Characteristics of hinge unknown. Dimensions (in mm.):–Height 34, length 44, depth 13, apical angle 120°(holotype).

Occurrence:—Rare.

Depository:— DGS, Reg. No. 1382 (Holotype).

Remarks:—This species is characterized by its transversely elongated shell, irregularly spaced concentric undulations and fine concentric threads, and large apical angle.

Clementia (*Egesta*) *martini* (CLARK) (WOODRING, 1926, p. 40, pl. 15, fig. 3) from the Miocene San Pablo formation, Catra Coasta County, California, resembles this species in having a transversely elongated shell, rather large apical angle, and in the sculpture of the external surface, but it is distinguishable from the present one by the proportion of length and height, details of the posterior margin, and by the shallowly concaved anterior margin. *Clementia nakamurai* OTUKA (OTUKA, 1938, p. 14, pl. 1, figs. 7, 11), a Miocene species of Japan differs from the present one in the nearly quadrate shell outline.

Family Tellinidae

Genus *Tellina* LINNAEUS, 1758

Tellina hamadai MASUDA, n. sp.

Pl. 19, figs. 10, 11.

Shell small in size, thin, compressed, transversely elongated; surface finely and concentrically sculptured; beaks small, approximate, pointed, and situated near middle of shell length. Antero-dorsal margin rather sharply sloping into narrowly rounded anterior side; postero-dorsal margin a little longer than anterior, nearly straight above and merging into rounded posterior side; ventral margin very broadly rounded or nearly straight; anterior and posterior ends rounded, the latter more broadly than the former which is more abrupt. Escutcheon narrow and short, slightly depressed. Surface sculpture consists of numerous, regular, close-set and fine concentric lines, and with faint fold from beak to anterior end. Interior characters inaccesible. Dimensions (in mm.):–Height 8.6, length 14.4, thickness 3.3 (holotype), height 5.5, length 9.5 (paratype).

Occurrence:—Common.

Depository:— DGS, Reg. No. 1657 (Holotype).

Remarks:—This species is characterized by its small, transversely elongated and compressed shell with fine, numerrous concentric lines on the surface and faint fold which extends from beak to anterior end. Among the paratype specimens there is one having the anterior end bent to the right.

This species more or less resembles *Tellina iridella* MARTENS (YOKOYAMA, 1924, p. 41, pl. 5, fig. 23) which is a Pleistocene and Recent species of Japan, but that species has a beak situated more posteriorly than the present species.

This species is named in honor of Mr. Akio HAMADA who helped the writer in the field.

Tellina notoensis MASUDA, n. sp.

Pl. 19, fig. 12.

Shell small, thin, compressed, transversely elongated, nearly equilateral; surface was probably finely and concentrically ornamented (original shell material not preserved); beaks small, pointed, and situated nearly at middle part of shell length. Antero-dorsal margin nearly straight, gently sloping anteriorly into well rounded anterior side; postero-dorsal margin nearly straight; anterior and posterior ends

regularly rounded; ventral margin very broadly rounded, or nearly straight. Escutcheon very narrow, depressed. Surface with weak fold extending from beak to anterior end. Pallial sinus very deep. Interior characters inaccesible. Dimensions (in mm.):–Height 12.5, length 23.0 (holotype).

Occurrence:—Rare.

Depository: — DGS, Reg. No. 2502 (Holotype).

Remarks—A single specimen lacking the original shell matter is in the collection. This species is distinguishable from *Tellina hamadai* described in this article by the larger size of the shell and nearly equilateral outline.

Family Skeneidae

Genus *Teinostoma* A. ADAMS, 1853

Teinostoma yabei MASUDA, n. sp.

Pl. 19, figs. 16-18.

Shell very small in size, lenticular in form; surface rather smooth, somewhat glassy, ornamented with microscopic network due to the crossing of spiral and longitudinal threads, making interspaces appear as elongated pits. Whorls about 4, nearly flat, rapidly enlarging, separated from each other by rather distinct, impressed sutures. Body whorl ventricose, with regularly rounded periphery; base a little concave; imperforate. Aperture nearly circular; outer lip thin, simple; inner lip stout, with widely spread, smooth callosity. Dimension (in mm.):–Height 1.8, maximum diameter 3.6 (holotype), height 1.9, diameter 4.1, height 1.5, diameter 2.8, height 1.7, diameter 3.4 (paratypes).

Occurrence:—Abundant.

Depository: — DGS, Reg. No. 1537 (Holotype).

Remarks:—This is a rare genus in the Cenozoic formations of Japan, and the present record may be the first.

Teinostoma smikron GARDNER (GARDNER, 1948, p. 187, pl. 25, figs. 18–20) from the Pliocene Waccamaw formation, Neills Eddy Landing, Cape Fear River, Columbus County, North Carolina, resembles this new species, but it differs from the present one by the callosity which is slightly sunken below the surrounding surface and the feeble sculpture.

This species is named in honor of Dr. Hisakatsu YABE, Emeritus Professor of the Tohoku University, who founded the Institute of Geology and Paleontology, Faculty of Science, Tohoku University, Sendai, Japan.

List of Fossils (*illustrated)

Genus and Species \ Localities	1	2	3	4	5	6	7	8
Acila sp.	F		R					
Ennucula sp.		R						
Nuculana sp.		R						
Barbatia cf. *uetsukiensis* HATAI and NISIYAMA*					F			
Anadara (*Anadara*) *kakehataensis* HATAI and NISIYAMA*					A			
Anadara (*Anadara*) *kurosedaniensis* HATAI and NISIYAMA					A			

List of Fossils (* illustrated)

Genus and Species \ Localities	1	2	3	4	5	6	7	8
Anadara cf. *makiyamai* HATAI and NISIYAMA	C	A	F	F		F		
Glycymeris cf. *rhynchonelloides* NOMURA and HATAI								C
Brachidontes sp.					C			
Lithophaga sp.				F				
Chlamys nisataiensis OTUKA				F		F		
Patinopecten kimurai (YOKOYAMA)		R						
Patinopecten sp.	R							
Placopecten sp.							R	
Monia radiata (DESHAYES)								F
Ostrea cf. *gigas* THUNBERG					F		F	
Ostrea gravitesta YOKOYAMA		A	C		F			
Ostrea sp.	F		F	F			F	F
Felaniella sp.					R			
Turas sp.				R				
Joannisiella meisensis MAKIYAMA*					F			
Lucinisca k-hataii (OTUKA)*					C			
Lucinisca sp.		F	F					
Papyridea sp.	R							
Clinocardium sp.	F	F		F	R			
Fulvia sp.					R			
Cyclina japonica KAMADA					A			
Pitar sp.		F						
Callista chinensis takagii MASUDA, n. subsp.*					F			
Dosinia cf. *nagaii* OTUKA		F						
Dosinia sp.	F					R	R	
Protothaca tateiwai MAKIYAMA		F						
Katelysia sp.		F						
Clementia japonica MASUDA, n. sp.*					R			

List of Fossils (* illustrated)

Genus and Species \ Localities	1	2	3	4	5	6	7	8
Clementia nakamurai OTUKA				F	F			
Clementia sp.	F					F		
Paphia cf. *hirabayasii* OTUKA		C				R		
Cardilia cf. *yudaensis* OTUKA							R	
Soletellina minoensis (YOKOYAMA)*					R			
Tellina hamadai MASUDA, n. sp.*					C			
Tellina notoensis MASUDA, n. sp.*					R			
Tellina sp.				R				
Macoma sp.								F
Solen cf. *gouldi* CONRAD*					R	R		
Phaxas cf. *izumoensis* (YOKOYAMA)*					A			
Thracia sp.				R				
Cryptomya busoensis YOKOYAMA					R			
Dentalium cf. *weinkaufii* DUNKER				R				
Dentalium sp.			R					
Margarites sp.		F						
Trochus sp.			R					
Calliostoma (*Fautor*) *namuchakuensis* HATAI and KOTAKA*		F			C			
Calliostoma (*Calotropis*) *simane* NOMURA and HATAI			R					
Teinostoma yabei MASUDA, n. sp.*					A			
Turritella sp.	F		F					
Vicarya callosa japonica YABE and HATAI*					C			
Vicaryella notoensis MASUDA, n sp.*					A			
Vicaryella sp.		F		R				
Cerithidea kanpokuensis (MAKIYAMA)*		C			R			
Cerithidea tokunariensis MASUDA, n. sp.*					A			
Cerithidea sp.		F						
Batillaria cf. *yamanarii* MAKIYAMA					C			

List of Fossils (* illustrated)

Genus and Species \ Localities	1	2	3	4	5	6	7	8
Proclava sp.		F						
Amathina sp.							R	
Polinices (*Euspira*) *meisensis* MAKIYAMA*		F			F			
Polinices (*Euspira*) *otukai* MASUDA, n. sp.*					R			
Polinices sp.		F						
Shichiheia yokoyamai (NOMURA and HATAI)		F						
Bursa sp.						R		
Chicoreus asanoi MASUDA, n. sp.*					A			
Chicoreus notoensis MASUDA, n. sp.*					F			
Chicoreus tateiwai HATAI and KOTAKA					F			
Neptunea sp.				R				
Phos sp.				R				
Nassarius notoensis MASUDA, n. sp.*					A			
Mitra sp.				R				
Turbonilla sp.					R			
Pyramidella hataii MASUDA, n. sp.*					R			
Acteocina hamadai MASUDA, n. sp.*					R			
Coptothyris grayi (DAVIDSON)								A

Loc. 1: Nishi-Innai, Najimi, Wajima-shi, Ishikawa Prefecture. Higashi-Innai formation (fine sandstone).

Loc. 2: Higashi-Innai, Najimi,Wajima-shi. Higashi-Innai formation (fine sandstone).

Loc. 3: Konishiyama, Najimi, Wajima-shi. Higashi-Innai formation (very fine sandstone).

Loc. 4: Tannoji, Onishiyama, Najimi, Wajima-shi. Higashi-Innai formation (medium sandstone).

Loc. 5: Tokunari, Machino-machi, Fugeshi-gun. Higashi-Innai formation (sandy mudstone containing much carbonaceous matter).

Loc. 6: Hizumewaki, Yanaida-mura, Fugeshi-gun. Higashi-Innai formation (very fine sandstone).

Loc. 7: Ishii, Yanaida-mura, Fugeshi-gun. Higashi-Innai formation (tuffaceous very fine sandstone).

Loc. 8: Wasumi, Yanaida-mura, Fugeshi-gun. Higashi-Innai formation (tuffaceous fine sandstone).

Abbreviation: A-abundant, more than 10 specimens; C-common, more than 5 specimens; F-few, more than 2 specimens; R-rare, only one specimen.

K. Kumagai photo.

Explanation of Plate 19

Fig. 1. *Barbatia* cf. *uetsukiensis* HATAI and NISIYAMA, DGS, Reg. No. 1387, Right valve, ×1. Loc. Tokunari, Machino-machi, Fugeshi-gun, Ishikawa Prefecture.

Figs. 2a-b. *Anadara* (*Anadara*) *kakehataensis* HATAI and NISIYAMA, DGS, Reg. No. 1383. a, Right valve, ×1. b, Posterior view of beaks and area of 2a, ×1. Loc. Same as above.

Fig. 3. *Anadara* (*Anadara*) *kurosedaniensis* HATAI and NISIYAMA, DGS, Reg. No. 1386. Left valve, ×1. Loc. Same as above.

Fig. 4. *Joannisiella meisensis* MAKIYAMA, DGS, Reg. No. 1193. Left valve, ×1. Loc. Same as above.

Figs. 5, 6. *Lucinisca k-hataii* (OTUKA), DGS, Reg. No. 1116. 5, Left valve, ×1. 6, Right valve, ×1. Loc. Same as above.

Fig. 7. *Callista chinensis takagii* MASUDA, n. subsp. Holotype, DGS, Reg. No. 2501. Right valve, ×1. Loc. Same as above.

Fig. 8. *Clementia japonica* MASUDA, n. sp. Holotype, DGS, Reg. No. 1382. Right valve, ×1. Loc. Same as above.

Fig. 9. *Soletellina minoensis* (YOKOYAMA), DGS, Reg. No. 1114. Internal mould of rigut valve, ×1. Loc. Same as above.

Fig. 10. *Tellina hamadai* MASUDA, n. sp. Holotype, DGS, Reg, No. 1657. Right valve, ×1. Loc. Same as above.

Fig. 11. *Tellina hamadai* MASUDA, n. sp. Paratype, DGS, Reg. No. 1657. Right valve, ×1. Loc. Same as above.

Fig. 12. *Tellina notoensis* MASUDA, n. sp. Holotype, DGS, Reg. No. 2502. Internal mould of right valve, ×1. Loc. Same as above.

Fig. 13. *Solen* cf. *gouldi* CONRAD, DGS, Reg. No. 2499. ×1. Loc. Same as above.

Figs. 14a-b. *Phâxas* cf. *izumoensis* (YOKOYAMA), DGS, Reg. No. 1112. a, Umbonal view, ×1. b, Left valve, ×1. Loc. Same as above.

Figs. 15a-b. *Calliostoma namuchakuensis* HATAI and KOTAKA, DGS, Reg. No. 1110. a, Apertural view, ×3. b, Dorsal view, ×3. Loc. Same as above.

Figs. 16a-c. *Teinostoma yabei* MASUDA, n. sp. Holotype, DGS, Reg. No. 1537. a, Apical view, ×8. b, Umbilical view, ×8. c, Apertural view, ×8. Loc. Same as above.

Figs. 17a-c, 18a-c. *Teinostoma yabei* MASUDA, n. sp. Paratypes, DGS, Reg. No. 1537. a, Apical view, ×8. b, Umbilical view, ×8. c, Apertural view, ×8. Loc. Same as above.

PROCEEDINGS OF THE PALAEONTOLOGICAL SOCIETY OF JAPAN

「日本古生物学会第 61 回例会」1955 年 6 月 18 日京都大学理学部地質学鉱物学教室に於いて開催した（参会者 23 名）。講演者並びに講演題目は次の通りである。

和歌山県湯浅産白堊紀の花粉・胞子化石 .... 島倉巳三郎

手取炭の古組織学的並びに花粉学的研究 .... 島倉巳三郎

On the "Retral Processes" in Some *Elphidium* (代読)..... Hiroshi UJIIE

On the Variation of *Elphidium crispum* sensu lato (代読)..... Yukinori FUJITA

Notes on the Osobudani Conglomerate of the Fukuji Ditrict, with Reference to Some Permian Fusulinids of its Limestone Pebbles (代読) ..... Hisayoshi IGO

On Some New Species of Genus *Rauserella* from Ibuki-yama, Shiga Prefecture, Central Japan (代読) ..... Manabu KOBAYASHI

淡路から産出した白堊紀海膽 *Echinocorys* について ..... 森下 晶

On the Form Variation of *Lima goliath* and its Allid Species ..... Shigeru AOKI

On Some Miocene Species of *Dosinia* from Japan (代読)..... Saburo KANNO

On *Lucinoma aokii*, A New species from the Pleistocene Deposits of Chiba Prefecture, Japan (代読) ..... Katsumi HIRAYAMA

Notes on Molluscan Fossils from Problematical Horizon of the Tomioka District, Northern Joban Coal-field, Japan (代読) ... . Katsumi HIRAYAMA

On the Molluscan Fauna found from the Northern District of Tanzawa Mountainland (代読) ..... Matsutaro SHIBATA

古瀬戸内第三系産の 2, 3 の *Glycymeris* について ..... 糸魚川淳二

古瀬戸内第三系産の Lucinidae について .... 糸魚川淳二

能登半島北部の中新世軟体動物について（その 1）(代読)..... 増田孝一郎

九州北西部における，いわゆる筑紫階の貝化石群の特徴（代読)..... 水野篤行

Founding of Problematic Fauna From the Abukuma Mountainland (代読) .... Masae OMORI and Abukuma group

淡路島の和泉層群産二枚介について
その 1: Taxodonta 及び Prionodonta
その 2: *Periplomya elliptica* NAGAO & OTATSUME の再検討..... .....市川浩一郎・前田保夫

Über die Pleurogrammatodontinae, eine Jüngmesozoische Prionodonte Unterfamilie .... Koichiro ICHIKAWA

Yebisites, a New Lower Jurassic Ammonite from Japan (代読)..... Tatsuro MATSUMOTO

On the Damesellidae and Kaolishaniinae with Notes on *Parakoldinioidia* and the so-called Wuting Trilobites (代読) ....Teiichi KOBAYASHI

Notes on the Cambrian Fossils from Yentzuyai, Tawenkou, Shantung (代読) ....Teiichi KOBAYASHI

Electron-microscopic Fine Structure of Fossil Diatoms IV .....Haruo OKUNO

A New Species of *Damesites* from Cenomanian of Hokkaido, Japan (代読) .... Rinji SAITO and Tatsuro MATSUMOTO

On *Myophoria goldfussi* var. *kobayashii* KAMBE .....Keiji NAKAZAWA

舞鶴帯中・下部三畳系の *Bakevellia* について... ..... 中沢圭二

Pseudorauserella, a New Permian Fusulinid Genus from the Kuma Massif, Kyushu, Japan (代読) .....Kametoshi KANMERA

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CONSTITUTION
of the
PALAEONTOLOGICAL SOCIETY OF JAPAN

ARTICLE 1. Name

The Society shall be known as the Palaeontological Society of Japan. The Society is a section of the Geological Society of Japan.

ARTICLE 2. Object

The object of the Society shall be to promote the study of palaeontology and related sciences.

ARTICLE 3. Achievement

The Society in order to execute Article 2 shall (a) issue the Society journal and other publications, (b) hold or sponsor scientific lectures and meetings, and (c) sponsor collecting or field trips, and lectures.

ARTICLE 4. Membership

The Society shall be composed of persons who are active of interested in palaeontology or related sciences, and shall be known as regular members, honorary members, and patrons.

ARTICLE 5. The members of the Society shall be obliged to pay annual dues to the Society, for which they shall enjoy the privilege of receiving the Society's journal and of submitting papers which have been read and discussed at the meetings for publication in the Society's journal.

ARTICLE 6. Administration

The Society shall have the following organizations for its administration.

(a) General meeting. The general meeting shall be composed of the Society members. More than one tenth of regular members shall be present to hold general meetings. Administrative affairs shall be decided during the general meeting.

(b) President. The president shall be elected from among the regular members. The president shall represent the Society and supervise its business matters.

(c) Council. The council shall be composed of councillors who are elected from among the regular members. The council shall discuss administrative affairs.

(d) Business council. The business councillors shall be elected from among the council members, and shall administer business affairs.

(e) Officers shall be elected by vote of returned mail ballots, as a general rule.

ARTICLE 7. Amendments to the constitution shall be by decision of the general meeting.

By-Laws and Administration

ARTICLE 8. The Society's journal shall be issued quarterly.

ARTICLE 9. Regular members shall be persons who have knowledge, experience, or interest in palaeontology or related sciences.

ARTICLE 10. Patrons shall be selected individuals or organizations who give special support to the objectives of the Society.

ARTICLE 11. Honorary members shall be persons of distinguished achievement in palaeontology. The council shall nominate honorary members for decision by the general meeting.

ARTICLE 12. Applicants for membership to the Society shall submit their full name, mailing address, date of birth, occupation, and name of school from which they graduated.

Dues

ARTICLE 13. Rates for annual dues of the Society shall be decided during the general meeting. Annual dues for regular members are Yen 600.00 (domestic members) and U.S. $3.00 (foreign members). Patrons are individuals or organizations donating more than Yen 15,000.00 annually. Honorary members are free from obligations.

ARTICLE 14. The Society income shall be from membership dues and bestowals.

ARTICLE 15. The Society shall have one chairman, fifteen councillors, and several business councillors, whose term of office shall be two years. They may be re-elected.

Addendum

ARTICLE 1. There shall be four business councillors for the present.